Chapter 4 Environmental Consequences

This section forms the scientific and analytic basis for the issue comparisons across alternatives. As a starting point, each alternative under consideration is perceived as having the potential to significantly affect one or more components of the human environment. Significance is determined by considering the context in which the action will occur and the intensity of the action. The context in which the action will occur includes the specific resources, ecosystem, and the human environment affected. The intensity of the action includes the type of impact (beneficial versus adverse), duration of impact (short versus long term), magnitude of impact (minor versus major), and degree of risk (high versus low level of probability of an impact occurring). Further tests of intensity include: (1) the potential for jeopardizing the sustainability of any target or non-target species; (2) substantial damage to ocean and coastal habitats and or essential fish habitat; (3) impacts on public health or safety; (4) impacts on endangered or threatened species, marine mammals, or critical habitat of these species; (5) cumulative adverse effects; (6) impacts on biodiversity and ecosystem function; (7) significant social or economic impacts; and (8) degree of controversy (NAO 216-6, Section 6.02).

Differences between direct and indirect effects are primarily linked to the time and place of impact. Direct effects are caused by the action and occur at the same time and place. Indirect effects occur later in time and/or further removed in distance from the direct effects (40 CFR 1508.27). For example, the direct effects of an alternative which lowers the harvest level of a targeted fishery could include a beneficial impact to the targeted stock of fish, a neutral impact on the ecosystem, and an adverse impact on net revenues to fishermen, while the indirect effects of that same alternative could include beneficial impacts on the ability of Steller sea lions to forage for prey, neutral impacts on incidental levels of prohibited species catch, and adverse impacts in the form of multiplier effects reducing employment and tax revenues to coastal fishing communities.

The terms "effects" and "impacts" were used interchangeably by analysts preparing these analyses. The CEQ regulations for implementing the procedural provisions of NEPA, also state "Effects and impacts as used in these regulations are synonymous." (40 CFR §1508.8). The terms "positive" and "beneficial", or "negative" and "adverse" are likewise used interchangeably in this analysis to indicate direction of intensity in significance determination.

Though the intent of the alternative fishery management schemes being proposed is to mitigate potential impacts of the federally managed groundfish fisheries off Alaska on Steller sea lions, the effects of the alternatives must be evaluated for all resources, species, and issues that may directly or indirectly interact with this fisheries within the action area. The direction of intensity, therefore, applies to the particular resource, species, or issue being evaluated (as opposed to always applying to Steller sea lions).

Each section below contains an explanation of the criteria used to establish significance and a determination of significance, insignificance or unknown for each resource, species, or issue being treated. The criteria for significance and determinations of significance are summarized in a table in each section, or when the same criteria were used to evaluate subsequent species, the reader is referred back to the appropriate table. The following ratings for significance are used; significant (beneficial or adverse), conditionally significant (beneficial or adverse), insignificant, and unknown. Definitions of the criteria used for these rankings are included in each section. Where sufficient information is available, the discussions and rating criteria used are quantitative in nature. In other instances, where less information on the direct and indirect effects of the alternative are available, the discussions and rating criteria used are qualitative in nature. In instances where criteria do determine an aspect of significance (significant negative, insignificant, or significant positive) because that aspect is not logically describable, no criteria are noted. These situations are termed "not applicable" or NA in the criteria tables. An example of an undescribable situation is evaluating the impact vector of incidental take on marine mammals. In that situation, criteria to determine significant adverse and insignificant are describable (though with less precision than perhaps desired by decision makers), however, within the band of effects known to be insignificant the point of no incidental take impact is reached, therefore, a criteria for significant beneficial is not applicable. Each resource section that follows contains a table summarizing the criteria used to determine significance for that particular resource.

The rating terminology used to determine significance are the same for each resource, species, or issue bing treated, however, the basic "perspective" or "reference point" differs depending on the resource, species or issue being treated. Table 4.0-1 summarizes the reference points for the topics addressed in this analysis. The first three reference points relate to the biological environment, while the later two are associated with the human environment. Social and economic consequences are not listed because the significance ratings were not similarly applied; rather, direct indicators of changes from current economic conditions were used. For each application listed in Table 4.0-1, one to five specific questions were addressed in the analysis. In each case, the questions were fundamentally tied to the respective reference point. The generic definitions for the assigned ratings are as follows:

S+ Significant beneficial effect in relation to the reference point; this determination is based on ample information and data and the judgement of the NMFS analysts who addressed the topic.

S- Significant adverse effect in relation to the reference point and based on ample information and data and the judgement of the NMFS analysts who addressed the topic.

CS+ Conditionally significant beneficial effect in relation to the reference point; this determination is lacking in quantitative data and information, however, the judgement of the NMFS analysts who addressed the topic is that the alternative will cause an improvement in the reference point condition.

CS- Conditionally significant adverse effect in relation to the reference point; it is based on insufficient data and information, however, professional judgement is that the alternative will cause a decline in the reference point condition.

I Insignificant effect in relation to the reference point; this determination is based upon information and data, along with the judgement of NMFS analysts, which suggests that the effects are small and within the "normal variability" surrounding the reference point.

U Unknown effect in relation to the reference point; this determination is characterized by the absence of information and data. In instances where the information available is not adequate to assess the significance of the impacts on the resource, species, or issue, no significance determination was made, rather the particular resource, species, or issue was rated as unknown.

In this analysis we use the term "conditionally significant" to describe a significant impact that is informed by incomplete or unavailable information. The conditional qualifier implies that significance is assumed, based on the credible scientific information and professional judgement that are available, but more complete information is needed for certainty. In other words, we may find that an impact has a significant adverse or a significant beneficial effect, but we do not have a high level of certainty about that finding. This approach provides a heightened sense of where information is lacking, and may guide research efforts in the future. An interesting point to make about this approach is that if an impact is rated as insignificant, there is a high level of confidence that the impact is truly insignificant, or it would have been moved to the "conditional significance" category.

Table 4.0-1 Reference points for significance determinations

Reference Point	Application
Current population trajectory or harvest rate of subject species	(1) Marine mammals (2) Target commercial fish species (3) Incidental catch of non-specified species (4) Forage species (5) Prohibited species bycatch (6) ESA list Pacific salmon (7) Seabirds
Current size and quality of marine benthic habitat and other essential fish habitat	Marine benthic habitat and other essential fish habitat
Application of principles of ecosystem management	Ecosystem
Current management and enforcement activities	(1) State of Alaska managed fisheries (2) Management complexity and enforcement
Current rates of fishing accidents	Human safety and private property (vessels)

4.1 Effects on Marine Mammals

The Draft Programmatic SEIS (NMFS 2001a) examined effects of groundfish fishery management alternatives by focusing analyses around four core questions, modified from Lowry (1982):

1. Is the alternative management regime consistent with efforts to avoid direct interactions with marine mammals (incidental take and entanglement in marine debris)?

2. Does the alternative management regime result in fisheries harvests on prey species of particular importance to marine mammals, at levels that could compromise foraging success (harvest of prey species)?

3. Does the alternative management regime result in temporal or spatial concentration of fishing effort in areas used for foraging by marine mammals (spatial and temporal concentration of removals with some likelihood of localized depletion)?

4. Does the alternative management regime modify marine mammal or forage behavior to the extent that population level impacts could occur (disturbance)?

Those four questions, and the associated rating criteria established (Tables 4.1-1 and 4.1-7), were modified for use in this analysis from the process used in the Draft Programmatic SEIS (NMFS 2001a). The main departure from how they were used in the Draft Programmatic SEIS analysis was it evaluated alternatives with respect to consistency with a policy of marine mammal protection, whereas, in this analysis each suite of specific fishery management measures is evaluated independently against a criteria for significance established for each of the four above questions. Additionally two management tools used in the Draft Programmatic SEIS are not relevant to discussions of effects on marine mammal populations: vessel monitoring requirements and experimental design. As the experimental designs being proposed are directed at gaining answers to questions about Steller sea lions, however, discussion was added (Section 4.1.1.6) evaluating the potential each alternative has for experiments designed to monitor Steller sea lion population recovery in response to the fishery management measures being manipulated, or to evaluate the localized effects of commercial fishing on Steller sea lions.

In cases where absolute quantitative criteria for significance could not be established, the fishery management measures in effect in 1998 were used as a benchmark upon which to compare these five alternatives with respect to effects on marine mammals, as expressed by the above questions. That is, once it was determined how much of an effect could be expected, as delineated by the above questions, other alternatives were evaluated relative to the performance of the 1998 benchmark.

This analysis is comprised of three tiers:

a. The effects on each of seven marine mammal species or species groups are discussed separately (Steller sea lions, ESA listed great whales, other cetaceans, northern fur seals, harbor seals, other pinnipeds, sea otters).
b. Each alternative is addressed for each species or species group.
c. Each question (type of effect) is addressed for each alternative within each species or species group.

4.1.1 Effects on Steller Sea Lions

Direct and indirect interactions between Steller sea lions and groundfish fisheries occur due to overlap in the size and species of groundfish harvested in the fisheries that are also important sea lion prey, and due to temporal and spatial overlap in sea lion foraging and commercial fishing activities. Of the groundfish species targeted for harvest, pollock, Atka mackerel, and Pacific cod rank foremost among important sea lion diet items (Sinclair and Zeppelin, submitted) and similar sizes are targeted by sea lions and fisheries. Thus subsequent analyses focus on effects of fisheries targeting those species. A metric was established (Table 4.1-6) for Steller sea lions to assess intensity of effects (harvest of prey species and spatial/temporal concentration, Question 3) and associated percent increase to populations, and new population trends for Steller sea lions. Significance ratings for each question are summarized in Table 4.1-6.

Evaluation of the effects of fisheries removals of groundfish on Steller sea lions require models that ultimately could relate fish biomass removed directly to changes in sea lion fecundity and survival. Such a model would do so across a broad range of temporal and spatial scales, incorporate potential changes in climate (Benson and Trites, 2000), and such a model does not currently exist. Several models have been developed to test hypotheses about the Bering Sea ecosystem and factors underlying past changes in Steller sea lion abundance (Pascual and Adkison, 1994; Trites *et al*., 1999; Shima *et al*., 2000), but these models are general in scope, generally not predictive, and those that could be predictive are limited because the degree of correspondence with the actual ecosystem is unknown (Trites et al., 1999). Other models, such as used by Livingston (2001) model multi-species interactions, but incorporate marine mammal abundance as an input rather than predictive output. One attempt at moving from global availability of groundfish to smaller spatial scales was the development of a forage-ratio model to determine whether the harvest under Alternative 4 would result in adverse modification of Steller sea lion critical habitat (Biological Opinion, Appendix A of this SEIS). This model required a number of assumptions, and was deemed to be most appropriate for large spatial scales. Analysis of finer spatial scales was performed qualitatively.

In the absence of models relating standing fish biomass to sea lion fecundity and survival, the effect on Steller sea lions by the harvest of prey species (Question 2) was analyzed in the draft of this analysis by examining differences among the Alternatives of TAC on broad geographic scales. Comments received from the NPFMC Scientific Statistical Committee (SSC) suggested that such an emphasis on global TAC was inconsistent with previous analyses suggesting global fishing removal levels did not constrain sea lions (NMFS, 2000a). To date, causal links have not been scientifically demonstrated between fishery harvests and marine mammal abundance (Northridge and Hofman, 1999; Bowen *et al*., 2001). In and of itself, TAC gives no indication of standing biomass remaining after fishing, and also requires an assumption that the benefits of unharvested biomass would benefit sea lions. We considered using exploitation rate, and the difference in estimated exploitable biomass and removals (what's left after fishing), as the metric for judging effects under Question 2. The problem with this approach is that the remaining standing biomass after fishing, in the same area where fishing and foraging co-occur, is unknown. Likewise, the difference in total estimated biomass when TAC is removed for each Alternative is relatively small, overall, and because this difference is so small the possible effect of the Alternatives on the marine mammal species in question could not be gauged. Also note that TAC for these fisheries is set under a process separate (which includes a separate NEPA analysis) than covered in this SEIS. However, it seems appropriate to evaluate any TAC differences that may exist among the Alternatives with respect to mitigation of impacts on Steller sea lions, and for potential impacts to other marine mammal species.

In response to comments, we used an analysis of daily removals for each alternative and a comparison of deviations from the mean daily removals calculated for all alternatives combined (see explanation under 4.1.1 and 4.1.1.1). These "deviation differences" were essentially the proportional residual of an Alternative's estimated daily removal from the average of all Alternatives removals for that day. Thus the "deviation differences" were independent of global TAC, yet would yield lower values if a particular Alternative had daily removal rates lower than the grand mean. This index, however, was overly sensitive to Alternatives that fished during periods closed under other Alternatives, regardless of the magnitude of removals. In addition, comments from the NPFMC SSC indicated the index was neither straightforward nor intuitive in its use (Scientific Statistical Committee, 2001). The SSC suggested an additional analysis based on the root mean square error (RMSE) of the daily removal rates, which is sensitive to TAC and variation in the estimated daily catch rates (SSC, 2001). Such an analysis (described in detail in 4.1.1 and 4.1.1.1) was added for this final SEIS. This index, however, does not distinguish among removals that may be generally lower than the combined daily average. Comparison of differences in actual TAC levels was incorporated into the overall judgement of effects by the analyst, but was a tertiary consideration in the evaluation. In the absence of models relating fish biomass to changes in sea lion survival or fecundity, the TAC, deviation difference, and RMSE analyses provide a quantitative means to compare the alternatives. Because sea lions and fisheries are dependent upon aggregations of prey species, changes in the standing biomass (and therefore overall TAC) may be less important to sea lions than local spatial and temporal removal patterns. Those effects were evaluated under Question 3.

All of these models assumed the following:

1. Low TAC is better for Steller sea lions,
2. A constant catch throughout the year is better,
3. There is a TAC that would have significantly positive effects to Steller sea lions compared to those presented in the Alternatives, and
4. There is a relationship (currently unquantified) between spatial and temporal concentrations of harvest and fecundity and survival of Steller sea lions.

An assumption that lower TAC would benefit sea lions is not as straightforward a conclusion as it should seem. Bioenergetic models suggest that on a gross scale the biomass remaining after fishing at current TAC's should be sufficient for sea lions, but those surplus fish may not benefit sea lions if distributed in such a way as to be unavailable for foraging (Winship, 2000). A multispecies model incorporating climate change with the effects of fishing on groundfish stocks suggested that no-fishing produced a smaller pollock spawning stock biomass than at $F_{40\%}$ and $F_{50\%}$ harvest rates (Livingston, 2001). Likewise, assuming that a constant catch throughout the year would benefit sea lions by minimizing spikes of removals and maintaining a higher standing biomass can be contrasted with findings of the Draft Programmatic SEIS (NMFS, 2001a), which found "short-burst" fishing beneficial so long as pulses occurred outside of critical life history periods. The timing of such pulses among these Alternatives is evaluated in Question 3 (spatial/temporal aspects). The notion of a TAC giving significantly positive benefits to sea lions relative to a reference point depends upon the reference used for comparison, such as no fishing, a mean of all Alternative TAC's (essentially the basis for the "deviation difference" analysis), or some other TAC. For the RMSE analysis we baaed an (S+) TAC on the Fowler and Perez (1999) model examining the range of variation observed for pollock consumption by predators in the Eastern Bering Sea ecosystem. As in the Draft Programmatic SEIS, (NMFS 2001a), we chose 1.6% of standing biomass as being a target harvest rate within the range of observed natural variation. This rate was applied to all groundfish stocks under consideration, and standing biomasses were taken from the 2000 stock assessment and fishery evaluation reports (NPFMC, 2000c; 2000d).

4.1.1.1 Effects of Alternative 1 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The estimated mean annual mortality from the 1995-1999 groundfish fisheries is 8.4 sea lions (Angliss *et al.*, 2001). Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)[1]. The estimated annual incidental take level of Steller sea lions under Alternative 1 in all areas combined is 13 Steller sea lions (with a confidence interval [CI] = 10 - 16 Steller sea lions; Table 4.1-2). Incidental bycatch frequencies, which are typically low, are summarized in Figure 4.1-4; they also reflect locations where fishing effort was highest. In the Aleutian Islands and GOA, incidental takes are often within critical habitat, though in the Bering Sea such bycatch is farther off shore and along the continental shelf. Otherwise there seems to be no apparent "hot spot" of incidental catch disproportionate with fishing effort. It is, therefore, appropriate to estimate catch ratios based on estimated TAC. Noting, however, that if these take rates differ between observed and unobserved vessels then these take estimates would be biased accordingly. These rates also reflect a

[1] Dan Ito, "Personal Communication," National Marine Fisheries Service, 7600 Sand Point Way NE, Seattle, WA 98115.

prohibition of trawling within 10 or 20 nm of 37 rookeries which likely reduces the potential for incidental take, particularly during the breeding season when females are on feeding trips within the critical habitat area. For Alternative 1, it is likely that the same amount of fishing effort will occur, regardless of the number of seasons (two in this alternative).

Entanglement of Steller sea lions in derelict fishing gear or other materials seems to occur at frequencies that do not have significant effects upon the population. From a sample of rookeries and haul-out sites in the Aleutian Islands, of 15,957 adults observed, Loughlin *et al.* (1986) found only 11 (0.07%) entangled in marine debris, some of which was derelict fishing gear. Observations of sea lions at Marmot Island for several months during the same year observed 2 of 2,200 adults (0.09%) entangled in marine debris. During 1993-1997, only one fishery-related stranding was reported from the range of the western stock, a sea lion observed in August 1997 with troll gear in its mouth and down its throat (Angliss *et al.*, in press). Entanglement of sea lions in derelict fishing gear or other marine debris does not appear to represent a significant threat to the population. In conclusion, incidental take and entanglement in marine debris under Alternative 1 is insignificant according to the criteria set for significance (Table 4.1-1).

<u>Direct Effects - Fisheries Harvest of Prey Species (Question 2)</u>

Daily average removal rates were calculated for each Alternative's proposed fishing seasons by dividing the allocated TAC for a season by the duration of that season, and summing as appropriate for pollock, Pacific cod, or Atka mackerel fisheries (Figure 4.1-5). If an Alternative proposed a daily catch limit lower than this daily average, then the value of the limit was used. Actual daily fisheries removal rates may be higher or lower than this value. Deviations from relative mean daily removals for each Alternative were obtained by calculating the average removal rate for each day for all Alternatives (a "grand average"; the zero line in Figure 4.1-6) then dividing that value into the daily average removal rate for each Alternative. For example, Figures 4.1-5, -7, and -9 provide the daily average removal rates for each Alternative calculated by seasonal TAC. Under Alternative 1, approximately 7,500 mt/day of pollock and cod are projected to be harvested on February 1 from the Eastern Bering Sea. In Figure 4.1-6, the deviation of this daily average removal rate from the average for all Alternatives on February 1 is about +0.4, suggesting that, compared to the other four Alternatives, more pollock and cod in the EBS will be removed on that day under Alternative 1 than with the other Alternatives. The effect of the Alternative was then judged based on the overall and seasonal daily average removals by summing the areas under the "curves" in Figures 4.1-6,-8, and -10 for the year resulting in a comparative value that we term the deviation difference (Table 4.1-3). Such values are used to distinguish the relative differences between the Alternatives; they are not additive nor can they be compared statistically. In this case, a positive value suggests more removals than the average and a negative value suggests less removals.

For Alternative 1, the deviation difference for pollock in the Bering Sea and the Aleutian Islands resulted in negative values (less fish removed) and positive values for the Gulf of Alaska (more fish removed). These values were subjectively appraised by the analyst as insignificant (-100 to +100) for pollock in the eastern Bering Sea and Aleutian Islands and Pacific cod in all areas (with cod removals in the Aleutian islands slightly into the CS- category. A CS- (+101 to +250) judgement was assigned to central Aleutian Island mackerel and Gulf of Alaska pollock. Pacific cod deviation differences varied by area but were all relatively small values except for a large positive value for Aleutian Islands cod, and Atka mackerel were both negative and positive. Overall, Alternative 1 had a -15 value, suggesting less fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of -15, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar for all Alternatives.

The combined TAC of all groundfish in the Bering Sea results in a bimodal peak of average removal rates during February through April, and September to November (Figure 4.1-5). Compared to removals in the Bering Sea for all other alternatives, Alternative 1 has relatively lower average daily removal rates during the late spring and summer, calculated as the deviation from the daily average removal rate averaged for all fisheries (Figure 4.1-6). Similar patterns are seen in the Aleutian Islands (Figure 4.1-7, Figure 4.1-8). In the GOA projected average daily removal rates of pollock and cod are highest in mid summer (Figure 4.1-9 and 4.1-10). The combined TAC of pollock, Pacific cod, and Atka mackerel under Alternative 1 is 1,831,297 mt (Table 4.1-4). TAC removals at those levels for pollock and Pacific cod, in concert with time and space considerations, were thought to be having a negative effects on Steller sea lions (NMFS 1998b).

A root mean square error (RMSE) index incorporating TAC and variability in the estimated daily catch rate was developed by comparing the average daily catch rate for the Alternative to a presumed (S+) rate based on a harvest of 1.6% of the standing biomass of the target species (see 4.1.1 for additional explanation). A daily catch rate (m) was estimated by dividing that TAC by 365 days for the species of interest, and a daily catch rate (dj) was calculated for the Alternative as above for the "deviation difference" analysis. The root mean square error (RMSE) was then calculated as:

$$RMSE = \sqrt{(S_{1\phi} - m)^2 / 365}$$

Alternative 1 had the highest RMSE value among all Alternatives (Table 4.1-5), mainly due to the large variance in daily catch rates (Figures 4.1-5 to 4.1-10) of all target species, rather than to differences in TAC (Table 4.1-4).

Groundfish fisheries also incidentally take other target fish and non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). The amount of these species removed under Alternative 1 is estimated to be less than 3% of the total catch in the Gulf of Alaska, and much lower than 3% of the total catch in the Bering Sea (NMFS unpublished observer program data)[2]. The combination of a negative average daily removal rate (deviation difference) resulting in an insignificant rating, and the TAC ranking of CS- resulted in an overall ranking of Insignificant for this Alternative under question 2.

<u>Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)</u>

Applicable to all fisheries, Alternative 1 contains closures within 10 nm of 37 rookeries to all trawling year-round, with some extending to 20 nm on a seasonal basis. Specifically, Alternative 1 contains the following:

The walleye pollock fishery in the BSAI has two seasons, January 20-April 15 (45% of TAC) and September 1-November 1 (55% of TAC). There are eastern BS and AI area apportionments of the TAC. GOA TAC is split into three seasons and the TAC is split 25%, 35%, and 45%, accordingly. Pollock trawling is closed in the CVOA June 10-December 31. The Pacific cod BSAI fishery is apportioned into three seasons and two gear types (trawl – January 20-December 31; and fixed – January 1 - December 31 in three seasons). The Pacific cod TAC is set BSAI-wide. In the GOA, fixed gear opens January 1 and trawl January 20; fishing occurs until the end of the year for both. The Atka mackerel fishery is in two seasons, January to April 15, and September 1 to November 1 with 50% of the TAC apportioned in each season. Atka mackerel harvest is limited to 40% of TAC inside Steller sea lion critical habitat. Compared to a temporally even removal

[2] Ibid.

rate, Alternative 1 had the greatest degree of variability of all Alternatives based on RMSE analysis (Table 4.1-5).

Sinclair and Zeppelin (submitted) showed that regions based on diet similarity closely paralleled the metapopulation clusters defined by York *et al.* (1996), in that Sinclair and Zeppelin's region 1 represents the eastern and central Gulf of Alaska as defined by York *et al.* (1996). Region 2 represents the western GOA in the York *et al.*(1996) scheme, region 3 represents the eastern Aleutian Islands, and region 4 the central and western Aleutian Islands. Because these two analyses result in similar clustering, population projections relevant to York *et al.* (1996) using those regions/areas (e.g., Figure 3.1-9) can be used in the context of comparing diet differences, fisheries allocations, and population trajectories. For this reason, the present analysis was based on Steller sea lion metapopulations rather than on the 13 monitoring areas proposed in NMFS (2000a) *per se*.

In addition, Loughlin and York (2001) provided an accounting of losses to the Steller sea lion population stratified by metapopulation areas using sources of known mortality, including subsistence harvest, incidental take in fisheries, illegal shooting, research, and predation by killer whales and sharks. Some portion of the remaining unknown mortality from the Loughlin and York (2001) study may be attributable to removal of prey by commercial fisheries. For example, in 2001, losses from a stable population would have been 4,710, with and additional 1,715 losses accounting for the decline. This totals 6,425 sea lions lost to the population. Of the 1,715 losses, 55%-75% could not be attributed to a specific cause. The following discussion incorporates analyses from Sinclair and Zeppelin (submitted), York *et al.* (1996), and Loughlin and York (2001) to assess the effect of the five alternatives on these losses that were not attributable to a specific source.

Effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and sea lion foraging. Benefits to sea lions are likely linked to the extent that an alternative reduces removals of key prey species within sea lion foraging areas, and during critical time periods such as April-June, when energy requirements of late-term pregnant females are greatest and pups from the prior year may begin weaning, and May-August, when females are tied to rookeries while nursing pups.

The proportion of pollock, Pacific cod, and Atka mackerel in the Steller sea lion diet varies by area and season (Figure 4.1-11, Figure 4.1-12). A recent study that examined sea lion scat (Sinclair and Zeppelin, submitted) showed that sea lion diet can be classified into four sea lion regional clusters (Figure 3.1-9). In region 1 (Prince William Sound to the Semidi Islands) pollock comprised 64% of the frequency of occurrence (FO) in summer (May-September) and 56% FO in winter (December-April) of the Steller sea lions diet. For region 2 (Shumagin Islands to the Sanak Islands) pollock comprised 80% FO in summer and 86% FO in winter. In region 3, (Sanak Islands to Ogchul Island) pollock comprised 54% FO in summer and 59% FO in winter. And in region 4 (all islands west of Umnak Island), pollock comprised 10% FO in summer and 3% FO in winter. Sinclair and Zeppelin (submitted) found that Pacific cod in region 1 during summer was 5% FO in summer and 31% FO in winter. In region 2, Pacific cod was 11% FO in summer and 36% FO in winter. For region 3, cod was 6% FO in summer and 20% FO in winter, and for region 4, cod was 7% FO in summer and 17% FO in winter. For Atka mackerel, Sinclair and Zeppelin (submitted), found no occurrence in summer and 2% FO in winter in region 1. For region 2, Atka mackerel occurrence was 2% FO in summer and 4% FO in winter; region 3 had 26% FO in summer and 25% FO in winter. And for region 4, Atka mackerel was 93% FO in summer and 65% FO in winter.

Based upon sea lion population trends during 1990-2000, it is assumed that Alternative 1 will not result in a stable population (Table 4.1-6). Thus, changes to the sea lion population would be within 2% of the current trend, and an overall decline would continue at -3.3% to -7.1% per year (Table 4.1-6). Overall, the effects of Alternative 1 are conditionally significant negative (Table 4.1-7) according to the criteria set for significance in Table 4.1-1.

Indirect Effects - Disturbance Effects (Question 4)

This and all other alternatives contain measures that avoid important forms of disturbance to Steller sea lions at rookeries during the breeding season. In particular, the prohibition of vessel entry within 3 nm of 37 rookeries avoids intentional and unintentional disturbance of hauled-out sea lions, including new born pups, or those animals aggregated near shore. More than 3,250 km^2 around 37 sites is offered for protection under this alternative.

Vessel traffic, nets moving through the water column, or underwater sound production may all represent perturbations, which could affect foraging behavior, but few data exist to determine their relevance to Steller sea lions. We note especially, that the influence of trawl activities on Steller sea lion foraging success cannot be addressed directly with existing data. Foraging could potentially be affected not only by interactions between vessel and sea lion, but also by changes in fish schooling behavior, distributions, or densities in response to harvesting activities. In other words, disturbance to the prey base may be as relevant a consideration as disturbance to the predator itself.

For the purposes of this analysis, we recognize that some level of prey disturbance may occur as a fisheries effect. The impact on marine mammals using those schools for prey is a function of both the amount of fishing activity and its concentration in space and time, neither of which may be extreme enough under Alternative 1 to represent population level concerns. To the extent that fishery management measures under Alternative 1 do impose limits on fishing activities inside critical habitat, we assume at least some protection is provided from these disturbance effects. These protections occur as byproducts of other actions which either reduce fishing effort or create buffer zones to limit impacts on foraging. Also, they occur directly in the case of the 3-nm, no-entry zones around rookeries. Whether the residual levels of disturbance represent significant effects on Steller sea lions can not be determined from data currently available.

Anecdotal evidence, however, suggests that fisheries-related disturbance events are unlikely to be of consequence to the Steller sea lion population as a whole. For instance, vessel traffic and underwater sound production have long been features of the Bering Sea and Gulf of Alaska, at least over much of the twentieth century. Such circumstances have prevailed before, as well as after, the decline of Steller sea lions, suggesting no obvious causal link. Steller sea lions also appear to be tolerant of at least some anthropogenic effects, as noted by their attraction to fish processing facilities and gillnets, as well as their distributions in proximity to ports. Further, the eastern stock of Steller sea lions is increasing, despite anthropogenic activities throughout their range on the west coast of North America and particularly in southeast Alaska. Overall, these circumstances suggest that disturbance effects are likely to be insignificant to Steller sea lions at the population response level. Thus, the effect of Alternative 1 is insignificant according to the criteria set for significance (Table 4.1-1).

4.1.1.2 Effects of Alternative 2 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

With regard to incidental take, Alternative 2 is not likely to result in significant changes in the rate of direct mortality relevant at the population level. Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)[3]. Takes of Steller sea lions currently are rare events in all Alaska groundfish fisheries, with no apparent pattern to their temporal or spatial distribution (Figure 4.1-4). For example, the total number of animals killed is expected to be less than 13 (as in Alternative 1) based on allocations of TAC in this Alternative, or about one sea lion per 140,000 mt of groundfish harvested (Table 4.1-2). The level of incidental take in either the BSAI or the GOA has not increased over the past decade (Figure 4.1-4).

Under Alternative 2, TACs for pollock, Pacific cod, and Atka mackerel are reduced; thus, proportional reductions in incidental take could be expected. However, the apportionment of the TAC reductions did not result in the reduction of the expected incidental catch of Steller sea lions (Table 4.1-2). Similarly, reduced fishing activity inside critical habitat, where Steller sea lions may be expected to spend a greater percentage of their foraging and transit time, could further lower incidental take. The overall effect of any such reductions on population trends, however, would be indistinguishable.

With respect to entanglement in marine debris, Alternative 2 does not alter the effects described under Alternative 1. That is, the effect is insignificant. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, Alternative 2 is rated insignificant according to the criteria set for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

As defined in 4.1.1.1 daily average removal rates were calculated for the proposed fishing season by dividing the allocated TAC for that season by the duration of the season, and summing as appropriate for pollock, Pacific cod, or Atka mackerel fisheries (Figure 4.1-5). Actual daily fisheries removal rates may be higher or lower than this value. Deviations from relative mean daily removals for each Alternative were obtained by calculating the average removal rate for each day for all Alternatives (a "grand average"; the zero line in Figure 4.1-6) then dividing that value into the daily average removal rate for each Alternative. For example, Figures 4.1-5, -7, and -9 provide the daily average removal rates for each Alternative calculated by seasonal TAC. Under Alternative 2, approximately 6,000 mt/day of pollock and cod were estimated to be harvested on February 1. In Figure 4.1-6, the deviation of this daily average removal rate on February 1 in Alternative 2 is about zero, suggesting that, compared to the other four Alternatives, the same amount of pollock and cod in the EBS will be removed on that day under Alternative 2 than with the other Alternatives. The effect of the Alternative was then judged based on the overall and seasonal daily average removals by summing the areas under the "curves" in Figures 4.1-6,-8, and -10 for the year resulting in a comparative value that we term the deviation difference (Table 4.1-3). Such values are used to distinguish the relative differences between the Alternatives; they are not additive nor can they be compared statistically. In this case, a positive value suggests more removals than the average and a negative value suggests less removals.

[3] Ibid.

For Alternative 2, the deviation difference for pollock in the Bering Sea resulted in +198 value (CS-), partly because this Alternative alone proposes seasonal fishing from November to December. Negative values (I to CS+) were calculated in the Aleutian Islands and Gulf of Alaska for pollock and cod. Atka mackerel removals were positive for the EBS/AI and western Aleutian Island (CS-) and insignificant for the central Aleutian. Overall, Alternative 2 had a +38 value (Table 4.1-3), suggesting more fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of +38, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar to all Alternatives.

The combined TAC of all groundfish in the Bering Sea results in quarterly peaks of average removal rates during February/March, April/June, July/August, and September/December (Figure 4.1-5). Compared to removals in the Bering Sea for all other alternatives, Alternative 2 has relatively equal average daily removal rates during most season except winter when the rates are the highest of any Alternative, calculated as the deviation from the daily average removal rate averaged for all fisheries (Figure 4.1-6). Different patterns are seen in the Aleutian Islands and Gulf of Alaska (Figure 4.1-7, -9 and Figures 4.1-8, -10) where the removal rates tend to be less than the mean daily removal rates.

The combined TAC of pollock, Pacific cod, and Atka mackerel under Alternative 2 is 1,646,297 mt (Table 4.1-4). The amount of the fishery removals of all key prey species is reduced by 10%. Reduced competitive effects, in turn, should avoid impacts on fitness or population recovery. Alternative 2 dampens the effects of harvest of the key prey species with different combinations of management measures, and includes reductions in TACs.

Reductions in TAC range from a low of 2% for eastern Bering Sea pollock to a high of 92% for Aleutian Islands pollock. Some of these reductions may be more important to Steller sea lions than others. For example, while a 92% reduction in Aleutians Islands pollock TAC is a large difference, diet studies indicate that pollock become less common in the diet of Steller sea lions in the Aleutian Islands than in the GOA and Bering Sea (Sinclair and Zeppelin, submitted). In addition to lowering TAC, spatial and temporal restrictions are discussed below.

Groundfish fisheries incidentally take some non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). The bycatch of these species under Alternative 2, however, is estimated to be less than 4% of the total catch in the Gulf of Alaska, and much lower in the Bering Sea (NMFS unpublished observer program data)[4].

A root mean square error (RMSE) index incorporating TAC and variability in the estimated daily catch rate was developed by comparing the average daily catch rate for the Alternative to a presumed (S+) rate based on a harvest of 1.6% of the standing biomass of the target species (see 4.1.1 for additional explanation). A daily catch rate (m) was estimated by dividing that TAC by 365 days for the species of interest, and a daily catch rate (dj) was calculated for the Alternative as above for the "deviation difference" analysis. The root mean square error (RMSE) was then calculated as:

$$RMSE = \sqrt{(S_{(dj - m)})^2 / 365}$$

[4]Ibid.

Alternative 2 had the lowest RMSE values among all Alternatives (Table 4.1-5), due to TAC reductions and temporal evenness of removals. There was little difference in RMSE among Alternative's 2-5 for the Eastern Bering Sea pollock fishery, and overall RMSE's were similar for Alternatives 2, 4, and 5 (Table 4.1-5).

Thus, Alternative 2 provides greater protection from effects of harvesting Steller sea lion prey species than Alternative 1. Further, the reductions in TACs are substantial enough (i.e., more than 20%, for two key species) to rank them as conditionally significant positive according to the significance criteria established in Table 4.1-1. The combination of a positive average daily removal rate (deviation difference) resulting in an insignificant rating, similar RMSE scores, and the TAC ranking of CS+, resulted in the assignment of an overall ranking of Insignificant for this Alternative under question 2.

<u>Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)</u>

Alternative 2 establishes lower total allowable catch levels (for pollock, Pacific cod, and Atka mackerel), prohibits trawling in critical habitat, and implements measures to spread out catches through the year. Applicable to all fisheries is no trawling for any groundfish species within Steller sea lion critical habitat. Relevant measures to the analysis include:

- Four seasons would be established for pollock, Pacific cod, and Atka mackerel fisheries with equal seasonal TAC apportionment: January 20 - March 15 (25%), April 1 - June 1 (25%), June 15 - August 15 (25%), September 1 - Dec 31 (25%). Two week stand-downs would be established between seasons with no rollover of TAC allowed.

Applicable to pollock fisheries:

- The Aleutian Islands would be closed to directed pollock fishing.
- Maximum TACs would be established as a percentage of the maximum ABC as follows: BS pollock TAC, 74.5% of ABC; GOA pollock TAC, 44.8% of ABC.
- Separate TACs would be established for Bering Sea pollock east and west of 170º W longitude, and GOA pollock TACS would be established by management area (e.g., 610, 620, 630) and for Shelikof Strait.
- Maximum daily catch limits would be established for the fleet of vessels fishing in the pollock fisheries as follows: BS pollock, 5,000 mt; GOA pollock, 1,000 mt.

Applicable to the Pacific cod fisheries:

- The Pacific cod TAC would be split from a combined BSAI TAC to separate TACs for the EBS and the AI based on the biomass distribution of the stock.
- Maximum TACs would be established as a percentage of the maximum ABC as follows: BS cod TAC, 71.8% of ABC; AI cod TAC, 71.8% of ABC; GOA cod TAC, 55.0% of ABC.
- Separate TACs would be established for Bering Sea cod east and west of 170º W longitude, separate AI cod TACs would be established by management area (e.g., 541, 542, 543); and GOA cod TACS would be established by management area (e.g., 610, 620, 630) and for the Shelikof Strait.
- Maximum daily catch limits would be established for the fleet of vessels fishing in the cod fisheries as follows: BS cod, 600 mt; AI cod, 600 mt; GOA cod, 400 mt.
- Foraging area (Seguam, SCA, Shelikof) catch limits would be established at 10% of survey biomass estimate.
- A zonal approach would be implemented for BSAI and GOA Pacific cod fisheries.

Applicable to Atka mackerel fisheries:

- Maximum mackerel TAC would be established at 33% of the maximum ABC.
- Separate TACs would be established for AI management areas (e.g., 541. 542, 543).
- A maximum daily catch limit of 300 mt would be established for the fleet of vessels fishing in the mackerel fishery.

As with Alternative 1, question 3, the effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and sea lion foraging.

For the central and eastern GOA metapopulation, a 55% reduction in pollock TAC and 38% reduction in cod TAC would likely benefit sea lion population trends, particularly during the winter when cod is more common in the diet. Closures of critical habitat to trawling could potentially provide a large degree of separation between fisheries removal and foraging which will also benefit sea lions. The same could be said for other metapopulations where the magnitude of TAC reduction is similar. Likewise, the spreading of allowable catch across four seasons with daily catch limits may reduce the likelihood of regional prey competition. However, determining the magnitude of the effect for this alternative on sea lion metapopulations in general is not possible, except that in most cases it is likely to be positive. The fine resolution of management suggested in this alternative exceeds the resolution available on Steller sea lions; thus the effects of Alternative 2 at the metapopulation level, or at finer scales, cannot be determined.

Daily average removal rates were calculated by dividing the allocated TAC by length of season, and summing, as appropriate, for open pollock, Pacific cod, or Atka mackerel fisheries. Actual daily fisheries removal rates may be higher or lower than this value. Projected average daily removal rates of pollock and cod in the Eastern Bering Sea are comparable in magnitude to the other alternatives (Figure 4.1-5, Figure 4.1-6), though with brief closures separating the fishing periods. Curiously, the pollock TAC allocated to the Eastern Bering Sea could not practically be removed because of daily catch limits. Under the management regime of Alternative 2, four seasons of 54 days (Season A), 61 days (B, C), and 121 days (D) were allocated 343,073 mt each, with no TAC rollover allowed between seasons (see Section 2.3.2). Average daily removal rates within each season to meet this TAC are 6353 mt, 5624 mt, 5624 mt and 2835 mt for the A through D seasons, respectively. However, Alternative 2 caps daily pollock removals from the Eastern Bering Sea at 5000 mt per day (Section 2.3.2), so without TAC rollover about 2601 mt would be forgone. This may have been an unintended consequence, because daily limits in the Gulf of Alaska and Aleutian Islands do not seem to result in “lost” TAC. The overall TAC of pollock and Pacific Cod in the Eastern Bering Sea is only reduced by 2% and 18%, respectively (Table 4.1-3). However, the percentage splits in allowed removals east and west of 170° W longitude of 52/48 (A season), 45/55 (B season), and 39/61 C and D seasons), combined with the daily catch limit of 1000 mt/d and no trawling within critical habitat should greatly reconfigure removals from east of 170° W, where most of the pollock were harvested during 1998-2000 (Figure 4.1-15). A similar split is made in pollock and Pacific cod allocations between western and central Gulf of Alaska TACs (see Section 2.3.2). Given the relatively large contribution of pollock in the summer and winter diets of sea lions in the Eastern Aleutian Islands (Figure 3.1-9, Figure 4.1-11, Figure 4.1-12), this could be beneficial to sea lions. Given seasonal movements of Steller sea lions among areas, and the variable amount of foraging occurring inside critical habitat even within a single foraging trip (Figure 4.1-13, Figure 4.1-14), it is not possible to predict how widespread such a benefit could be to the sea lion population in general. Within the western stock of Steller sea lions, the Eastern Aleutian Island metapopulation has exhibited the lowest annual decline rate (-1.75% during 1991-2000) (Loughlin and York 2001).

Because of reduced pollock, Pacific cod, and Atka mackerel TACs in the Gulf of Alaska and Aleutian Islands, average daily removal rates are lower than in the other alternatives (Figure 4.1-7, Figure 4.1-8, Figure 4.1-9, Figure 4.1-10). Also in contrast to other alternatives, Alternative 2 prevents greater removal rates during critical periods of April-June (late pregnancy and beginning of pup weaning) and May-July (pup lactation period on rookeries). Of all the alternatives, Alternative 2 measures appear to result in the least temporal concentration of fishery removals of key sea lion prey species.

Alternative 2 management measures result in much less spatial and temporal concentration of fisheries removals of key Steller sea lion prey species than do measures under other alternatives, and hence rates a conditionally significant positive using the criteria established for significance (Table 4.1-1). The overall TAC, however, is only 10% less than the other alternatives (Table 4.1-4), and thus the overall effect on the population may not be as intense. Based upon Steller sea lion population trends during 1990-2000, it is assumed that Alternative 2 will not result in a stable population, changes to the sea lion population would be within 4% of the current trend, and an overall decline would continue at -1.4% to -2.3% per year (Table 4.1-6).

Indirect Effects - Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, disturbance effects by groundfish fisheries on Steller sea lions cannot be demonstrated with existing data. However, to the extent that Alternative 2 reduces fishing activities inside critical habitat and at haul-out sites, the former by extending closed areas and the latter by a reduction in TACs for pollock, Pacific cod, and Atka mackerel, potential disturbance effects may be further reduced or avoided. Thus, the scale of change in fishing activity imposed under Alternative 2 would result in less disturbance. Given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established (Table 4.1-1), measures which would result in even less disturbance than that which is insignificant are also rated as insignificant.

4.1.1.3 The effects of Alternative 3 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

With regard to incidental take, Alternative 3 is not likely to result in significant changes in the rate of direct mortality relevant at the population level. Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)[5]. Takes of Steller sea lions currently are rare events in all of the Alaskan groundfish fisheries, with no apparent pattern to their temporal or spatial distribution. For example, the total numbers of incidental take is expected to be less than 14 (CI = 11-17) based on allocations of TAC in Alternative 3, or about one sea lion per 140,000 mt of groundfish harvested (Table 4.1-2). The level of incidental take in either the BSAI or the GOA has not increased over the past decade (Figure 4.1-4).

With respect to entanglement in marine debris, Alternative 3 does not alter the effects described under Alternative 1. That is, there is an insignificant effect. Although the levels of protection from direct effects

[5] Ibid.

are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, Alternative 3 is rated insignificant according to the criteria set for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

As defined in 4.1.1.1, daily average removal rates were calculated for the proposed fishing season by dividing the allocated TAC for that season by the duration of the season, and summing as appropriate for pollock, Pacific cod, or Atka mackerel fisheries (Figure 4.1-5). Actual daily fisheries removal rates may be higher or lower than this value. Deviations from relative mean daily removals for each Alternative were obtained by calculating the average removal rate for each day for all Alternatives (a "grand average"; the zero line in Figure 4.1-6) then dividing that value into the daily average removal rate for each Alternative. For example, Figures 4.1-5, -7, and -9 provide the daily average removal rates for each Alternative calculated by seasonal TAC. Under Alternative 3, approximately 4,300 mt/day of pollock and cod were estimated to be harvested on February 1 from the Eastern Bering Sea. In Figure 4.1-6, the deviation of this daily average removal rate on February 1 in Alternative 3 is about -0.2, suggesting that, compared to the other four Alternatives, less pollock and cod in the EBS will be removed on that day under Alternative 3 than with the other Alternatives. The effect of the Alternative was then judged based on the overall and seasonal daily average removals by summing the areas under the "curves" in Figures 4.1-6,-8, and -10 for the year resulting in a comparative value that we term the deviation difference (Table 4.1-3). Such values are used to distinguish the relative differences between the Alternatives; they are not additive nor can they be compared statistically. In this case, a positive value suggests more removals than the average and a negative value suggests less removals.

For Alternative 3, the deviation difference for pollock in the Bering Sea resulted in -36 (I), but high variability occurred by area with the Aleutian Islands ranking as S-, and all other areas as CS-. Pacific cod removals overall ranked as CS+ in the Aleutian Islands and insignificant elsewhere. Atka mackerel removals under Alternative 3 all resulted in positive values with a CS- ranking for the EBSAI area and insignificant for other areas (Table 4.1-3). Overall, Alternative 3 had a -49 value, suggesting less fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of -49, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar to all Alternatives.

The combined TAC of all groundfish in the Bering Sea results in relatively constant average removal rates from February through November with an increase of about 2,000 mt/day July to November (Figure 4.1-5). Compared to removals in the Bering Sea for all other alternatives, Alternative 3 has relatively equal average daily removal rates during most season, calculated as the deviation from the daily average removal rate averaged for all fisheries (Figure 4.1-6).

The combined TAC of pollock, Pacific cod, and Atka mackerel under Alternative 3 is 1,813,830 mt (Table 4.1-4). Alternative 3 contains a "global control rule" that adjusts TAC relative to surveyed spawning biomass. However, the projected TAC does not differ substantially from that of Alternative 1 (or for that matter Alternatives 4 and 5; Table 4.1-4). The largest (and only) reduction is in GOA pollock which is 18% less than the TAC established in Alternative 1.

A root mean square error (RMSE) index incorporating TAC and variability in the estimated daily catch rate was developed by comparing the average daily catch rate for the Alternative to a presumed (S+) rate based on a harvest of 1.6% of the standing biomass of the target species (see 4.1.1 for additional explanation). A daily catch rate (m) was estimated by dividing that TAC by 365 days for the species of interest, and a daily catch rate (dj) was calculated for the Alternative as above for the "deviation difference" analysis. The root mean square error (RMSE) was then calculated as:

$$RMSE = \sqrt{(S_{1\phi - m})^2 / 365}$$

Alternative 3 had the second highest RMSE value among all Alternatives (Table 4.1-5), mainly due to the large variance in daily catch rates (Figures 4.1-5 to 4.1-10) of Aleutian Island pollock and Gulf of Alaska Pacific cod, rather than to differences in TAC (Table 4.1-4).

Groundfish fisheries also incidentally take non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). However, the bycatch of these species under Alternative 3 is estimated to be less than 4% of the total catch in the Gulf of Alaska, and much lower in the Bering Sea (NMFS unpublished observer program data)[6].

Alternative 3 contains additional management measures beyond those used under Alternative 1 to manage the harvest within critical habitat. Because GOA TAC is reduced between 5% and 20%, using the criteria for determining significance in Table 4.1-1 the effect on Steller sea lion populations under Alternative 3 is rated insignificant (Table 4.1-7). The combination of a negative average daily removal rate (deviation difference) resulting in an insignificant rating, and the TAC ranking of CS-, therefore the analyst assigned an overall ranking of Insignificant for this Alternative under question 2.

<u>Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)</u>

Essential spatial and temporal elements of this approach are to establish large areas of critical habitat where fishing for pollock, Pacific cod, and Atka mackerel is prohibited, and to restrict catch levels in remaining critical habitat areas. Details are as follows:

Applicable to all pollock, Pacific cod and Atka mackerel fisheries:

- Closure areas to directed fishing for pollock, Pacific cod, and Atka mackerel inside specified sites.
- Trawl fishing for pollock, Pacific cod and Atka mackerel prohibited November 1 January 20.
- Fishing for pollock, Pacific cod and Atka mackerel prohibited from November 1 through January 20 inside critical habitat.
- Outside of critical habitat, two evenly spaced seasons for pollock, Pacific cod, and Atka mackerel fisheries in the EBS, GOA, and AI.

Applicable to pollock fisheries:
- A portion of the Aleutian Islands would be open to pollock fishing (Area 12)

Applicable to the Pacific cod fisheries:
- The Pacific cod TAC would be split from a combined BSAI TAC to separate TACs for the EBS and the AI based on the biomass distribution of the stock.

As with Alternatives 1 and 2, the effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and

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[6] Ibid.

location of fisheries removals relative to the importance of the target species in Steller sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and sea lion foraging.

Alternative 3 reduces spatial concentration by creating large closures within three broad areas, prohibiting fishing within critical habitat during November 1 through January 20, and creates four rather than two seasons within critical habitat which along with catch limits reduce spatial concentration of fisheries removals. Overall average daily removal rates for Eastern Bering Sea pollock and Pacific cod are fairly evenly distributed throughout the year (Figure 4.1-5, Figure 4.1-6). Likewise, Aleutian Island pollock, Atka mackerel and Pacific cod estimated average daily removal rates are even throughout the year (Figure 4.1-7), though relative to removals of all other alternatives is relatively greater during June through September (Figure 4.1-8), a critical period for Steller sea lion lactation. Similarly, GOA Pacific cod and pollock have relatively greater estimated average daily removal rates and similar TAC allocations compared to other alternatives during June through September, though there are removal limits within critical habitat.

Alternative 3 generally spreads fish removals over time and seasons, and thus results in marginally less spatial and temporal concentration of fisheries removals than Alternative 1, and hence rates as insignificant using the criteria established for significance (Table 4.1-1). The overall TAC, however, is similar to all other Alternatives except Alternative 2, which may reduce the benefit to Steller sea lions. Based upon sea lion population trends during 1990-2000, it is assumed that Alternative 3 will not result in a stable population. Thus, changes to the Steller sea lion population would be within 2% of the current trend, and an overall decline would likely continue at -1.4% to -5.2% per year (Table 4.1-6). Overall, using the criteria for determining significance in Table 4.1-1 the effect on Steller sea lion populations under Alternative 3 is rated conditionally significant positive (Table 4.1-7).

Indirect Effects - Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on Steller sea lions cannot be demonstrated with existing data. However, Alternative 3 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 3 nm of haul-out sites. It also contains a minor reduction in TACs of less than 1% for pollock, Pacific cod, and Atka mackerel resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Thus, the scale of change in fishing activity imposed under Alternative 3 results in marginally less disturbance. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, rated insignificant according to the criteria set for significance (Table 4.1-1).

4.1.1.4 The effects of Alternative 4 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)[7]. The total amount of incidental take under Alternative 4 is expected to be less than 13 (as in Alternative 1) based on allocations of TAC in this

[7]Ibid.

Alternative, or about one sea lion per 140,000 mt of groundfish harvested. The level of incidental take in either the BSAI or the GOA has not increased over the past decade.

With respect to entanglement in marine debris, Alternative 4 does not alter the effects described under Alternative 1. That is, there is no significant effect. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, Alternative 4 is rated as insignificant under the criteria established for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

As defined in 4.1.1.2, daily average removal rates were calculated for the proposed fishing season by dividing the allocated TAC for that season by the duration of the season, and summing as appropriate for pollock, Pacific cod, or Atka mackerel fisheries (Figure 4.1-5). Actual daily fisheries removal rates may be higher or lower than this value. Deviations from relative mean daily removals for each Alternative were obtained by calculating the average removal rate for each day for all Alternatives (a "grand average"; the zero line in Figure 4.1-6) then dividing that value into the daily average removal rate for each Alternative. For example, Figures 4.1-5, -7, and -9 provide the daily average removal rates for each Alternative calculated by seasonal TAC. Under Alternative 4, approximately 4,700 mt/day of pollock and were projected to be harvested on February 1 from the Eastern Bering Sea. In Figure 4.1-6, the deviation of this daily average removal rate on February 1 in Alternative 4 is about -0.1, suggesting that, compared to the other four Alternatives, less pollock and cod in the EBS will be removed on that day under Alternative 4 than with the other Alternatives. The effect of the Alternative was then judged based on the overall and seasonal daily average removals by summing the areas under the "curves" in Figures 4.1-6,-8, and -10 for the year resulting in a comparative value that we term the deviation difference (Table 4.1-3). Such values are used to distinguish the relative differences between the Alternatives; they are not additive nor can they be compared statistically. In this case, a positive value suggests more removals than the average and a negative value suggests less removals.

For Alternative 4, the deviation difference for pollock in the Bering Sea resulted in -29 (CS+), but high variability occurred by area with the Aleutian Islands ranking as S- with a value of +470, and all other areas as CS-. Pacific cod removals overall ranked as S- in the Aleutian Islands and CS- elsewhere. Atka mackerel removals under Alternative 4 all resulted in negative values with a CS+ ranking (Table 4.1-3). Overall, Alternative had a +58 value, suggesting more fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of +58, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar for all Alternatives.

The combined TAC of all groundfish in the Bering Sea results in relatively constant average removal rates from February through November with an increase of about 2,000 mt/day July to November (Figure 4.1-5). Compared to removals in the Bering Sea for all other alternatives, Alternative 4 has relatively equal average daily removal rates during most seasons, calculated as the deviation from the daily average removal rate averaged for all fisheries (Figure 4.1-6). The exception is the high removal of cod during winter when such fishing is not proposed in the other Alternatives.

The combined TAC of pollock, Pacific cod, and Atka mackerel under Alternative 4 is 1,831,299 mt, virtually the same as Alternatives 1, 3, and 5 (Table 4.1-4). Estimated TACs region-wide are the same as under Alternative 1. Alternative 4 contains additional seasonal and gear apportionments to distribute catch relative to Alternative 1.

A root mean square error (RMSE) index incorporating TAC and variability in the estimated daily catch rate was developed by comparing the average daily catch rate for the Alternative to a presumed (S+) rate based on a harvest of 1.6% of the standing biomass of the target species (see 4.1.1 for additional explanation). A daily catch rate (m) was estimated by dividing that TAC by 365 days for the species of interest, and a daily catch rate (dj) was calculated for the Alternative as above for the "deviation difference" analysis. The root mean square error (RMSE) was then calculated as:

$$RMSE = \sqrt{(S_{1.6 - m})^2 / 365}$$

Alternative 4 had an overall RMSE value similar to Alternatives 2, and 5, and an Eastern Bering Sea pollock RMSE similar to Alternatives 2-5 (Table 4.1-5). Alternative 4 had the highest RMSE value for BSAI Pacific cod due to greater variability in daily harvest rates (Figures 4.1-5 to 4.1-8), rather than to differences in TAC (Table 4.1-4).

Groundfish fisheries also incidentally take non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). However, the bycatch of these species under Alternative 4 is estimated to be less than 4% of the total catch in the GOA, and much lower in the Bering Sea (NMFS unpublished observer program data)[9].

Because the TAC is identical to that of Alternative 1, no additional benefits to Steller sea lions accrue. Therefore, this alternative is rated conditionally significant negative (Table 4.1-7) for TAC according to the criteria established for determining significance in Table 4.1-1. The combination of a negative average daily removal rate (deviation difference) resulting in an insignificant rating, similar RMSE values, and the TAC ranking of CS-, resulted in an overall ranking of Insignificant for this Alternative under question 2.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

This approach allows for different types of management measures in the three areas (AI, BS, and GOA). Essential measures include fishery specific closed areas around rookeries and haul-out sites, together with seasons and catch apportionments. Specific measures are complex and will not be repeated here, they are fully discussed in Section 2.3.4 Alternative 4.

As with Alternatives 1, 2, and 3, the effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and Steller sea lion foraging.

Two Eastern Bering Sea pollock and Pacific cod seasons provide fairly uniform estimated average daily removal rates throughout the year, though slightly increased during July-November due to a larger TAC apportionment (Figure 4.1-5, Figure 4.1-6). Temporal distribution of average daily removals is similar to Alternatives 3 and 5. In contrast, combined estimated average daily removal rates of Atka mackerel, pollock, and Pacific cod were the largest of all Alternatives in the Aleutian Islands (Figure 4.1-7, Figure 4.1-8), and particularly greater during the critical spring period (Figure 4.1-8). Gulf of Alaska removals are concentrated in four periods, though estimated removal rates are generally lower relative to other alternatives in spring and summer (Figure 4.1-9, Figure 4.1-10).

Alternative 4 also creates a series of area closures or removal limits to spatially spread fish removals. Management Areas 4 and 9 and the Seguam foraging area are closed to fishing for pollock, Pacific cod and Atka mackerel, and within 20 nm of five northern Bering Sea haul-outs (NMFS 2000 Biological Opinion). The closures of these areas is not likely be of great benefit to sea lions, however, as the amount of pollock (Figure 4.1-15) and Pacific cod (Figure 4.1-16) catch, and Atka mackerel effort (Figure 4.1-17) during 1998-2000 in these areas was minimal. Similarly, because pollock are not a key item in Steller sea lion diet west of 170°W longitude (Figure 4.1-11, Figure 4.1-12), prohibiting pollock fishing in the Aleutian Islands may have little benefit to sea lions. Closures to pollock fishing out to 10 or 20 nm around most rookeries and haul-outs in GOA management Areas 1, 2, 3, 4, 5, 6, 10 and 11 could be beneficial to sea lions given the importance of pollock in their diet in those areas (Figure 4.1-11, Figure 4.1-12), particularly during periods of pup rearing when mothers forage from the rookeries. The benefit of these closures outside of the pupping season becomes less clear, given seasonal movements of Steller sea lions among areas, much greater home ranges during winter (see Section 3.1.1.7.2) and the variable amount of foraging occurring inside critical habitat even within a single foraging trip (Figure 4.1-13, Figure 4.1-14).

Fisheries allocations are shifted by gear types, seasons, and areas, and represent improvements over Alternative 1 in some areas, the measures under Alternative 4 are rated as insignificant under the criteria established for significance (Table 4.1-1). Additionally, the overall amount of TAC removed is the same as all other alternatives except Alternatives 2 and 5. As with the other alternatives, given seasonal movements of Steller sea lions among areas, and the variable amount of foraging occurring inside critical habitat even within a single foraging trip (Figure 4.1-13, Figure 4.1-14), it is not possible to predict how widespread the effects of these measures are to the Steller sea lion population in general. Based upon Steller sea lion population trends during 1990-2000, it is assumed that Alternative 4 will not result in a stable population. Thus, changes to the sea lion population would be within 2% of the current trend, and an overall decline would continue at -3.3% to -7.1% per year (Table 4.1-6).

Indirect Effects - Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on Steller sea lions cannot be demonstrated with existing data. However, Alternative 4 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 3 nm of haul-out sites. It also contains a variety of schemes to reduce fisheries impacts on Steller sea lions across the GOA and Aleutian Islands. However, the overall TAC is the same as in Alternative 1 for pollock, Pacific cod, and Atka mackerel resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Thus, the scale of change in fishing activity imposed under Alternative 4 results in marginally less disturbance. Although the levels of protection from disturbance effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, Alternative 4 is rated insignificant according to the criteria set for significance (Table 4.1-1).

4.1.1.5 The Effects of Alternative 5 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)[8]. The total amount of incidental take under Alternative 5 is expected to be less than 14 (CI = 11-17) Steller sea lions (as in Alternative 1) based on allocations of TAC under Alternative 5, or about one sea lion per 140,000 mt of groundfish harvested (Table 4.1-2). The level of incidental take in either the BSAI or the GOA has not increased over the past decade (Figure 4.1-4).

With respect to entanglement in marine debris, Alternative 5 does not alter the effects described under Alternative 1. That is, there is an insignificant effect. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, rated insignificant according to the criteria set for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

As defined in 4.1.1.2, daily average removal rates were calculated for the proposed fishing season by dividing the allocated TAC for that season by the duration of the season, and summing as appropriate for pollock, Pacific cod, or Atka mackerel fisheries (Figure 4.1-5). Actual daily fisheries removal rates may be higher or lower than this value. Deviations from relative mean daily removals for each Alternative were obtained by calculating the average removal rate for each day for all Alternatives (a "grand average"; the zero line in Figure 4.1-6) then dividing that value into the daily average removal rate for each Alternative. For example, Figures 4.1-5, -7, and -9 provide the daily average removal rates for each Alternative calculated by seasonal TAC. Under Alternative 5, approximately 4,500 mt/day of pollock and cod were estimated to be harvested on February 1 from the Eastern Bering Sea. In Figure 4.1-6, the deviation of this daily average removal rate on February 1 in Alternative 5 is about -0.2, suggesting that, compared to the other four Alternatives, less pollock and cod in the EBS will be removed on that day under Alternative 5 than with the other Alternatives. The effect of the Alternative was then judged based on the overall and seasonal daily average removals by summing the areas under the "curves" in Figures 4.1-6,-8, and -10 for the year resulting in a comparative value that we term the deviation difference (Table 4.1-3). Such values are used to distinguish the relative differences between the Alternatives; they are not additive nor can they be compared statistically. In this case, a positive value suggests more removals than the average and a negative value suggests less removals.

For Alternative 5, the deviation difference for pollock in the Bering Sea resulted in -40 (CS+), but high variability occurred by area with the Aleutian Islands ranking as S+, and all other areas as CS+. Pacific cod removals overall ranked as CS- in the Aleutian Islands, insignificant in the BSAI, and CS- elsewhere. Atka mackerel removals under Alternative 5 all resulted in negative values with insignificant rankings for all areas (Table 4.1-3). Overall, Alternative 5 had a -31 value, suggesting less fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of -49, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar for all Alternatives.

The combined TAC of all groundfish in the Bering Sea results in relatively constant average removal rates from February through November with an increase of about 2,000 mt/day July to November (Figure 4.1-5). Compared to removals in the Bering Sea for all other alternatives, Alternative 3 has relatively equal average daily removal rates during most season, calculated as the deviation from the daily average removal rate averaged for all fisheries (Figure 4.1-6).

[8] Ibid.

The TAC of pollock, Pacific cod, and Atka mackerel under Alternative 5 is 1,809,497 mt, virtually the same as Alternatives 1, 3, and 4 (Table 4.1-4). The only reduction in TAC results from a prohibition on fishing for pollock in the Aleutian Islands, as in Alternative 2. The benefit to Steller sea lions from this reduction is equivocal. Diet studies indicate that pollock becomes less common in the diet of Steller sea lions in the Aleutian Islands than in the GOA and Bering Sea (Sinclair and Zeppelin, submitted). This alternative limits the amount of catch within critical habitat to be in proportion to estimated fish biomass.

A root mean square error (RMSE) index incorporating TAC and variability in the estimated daily catch rate was developed by comparing the average daily catch rate for the Alternative to a presumed (S+) rate based on a harvest of 1.6% of the standing biomass of the target species (see 4.1.1 for additional explanation). A daily catch rate (m) was estimated by dividing that TAC by 365 days for the species of interest, and a daily catch rate (dj) was calculated for the Alternative as above for the "deviation difference" analysis. The root mean square error (RMSE) was then calculated as:

$$RMSE = \sqrt{(S_{1\phi - m})^2 / 365}$$

Alternative 5 had RMSE values similar to Alternatives 2-4 (Table 4.1-5), though was similar to Alternative 2 with the lowest RMSE values for Aleutian Islands pollock through TAC reduction ((Table 4.1-4).

Groundfish fisheries also incidentally take other target and non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). The amount of bycatch of these species under Alternative 5 is estimated to be less than 4% of the total catch in the GOA, and much lower in the Bering Sea (NMFS unpublished observer program data)[9].

Because TAC under Alternative 5 is within 5% of the Alternative 1 TAC, this alternative is rated as conditionally significant negative (Table 4.1-7) for TAC according to the criteria set for significance in Table 4.1-1. The combination of a negative average daily removal rate (deviation difference) resulting in an insignificant rating, similar RMSE values, and the TAC ranking of CS-, resulted in an overall ranking of Insignificant for this Alternative under question 2.

<u>Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)</u>

Features of this alternative applicable to pollock fisheries include:

- In the Bering Sea pollock fishery: four seasons with harvest limits within sea lion critical habitat foraging areas; and two seasons (40:60% allocation) outside critical habitat.
- In the GOA pollock fishery: fishery distributed over 4 seasons (30%, 15%, 30%, 25%).
- The Aleutian Islands area would be closed to pollock fishing.

Applicable to the Atka mackerel fisheries:

- Two seasons with TAC apportionments would be established: January 20 - April 15 (50%); September 1 - November 1 (50%).
- Harvest limits would be established in critical habitat: (40% inside critical habitat, and 60% outside)

[9] Ibid.

Applicable to the Pacific cod fisheries:

- In the BSAI cod fishery: separate TACs would be established for the Bering Sea and Aleutian Islands, two seasons (A season Jan 20-April 30 at 40% of TAC; B season May 1-November 1 at 60% of TAC) with harvest limits within critical habitat based on best estimates of biomass. Using these estimates, the Bering Sea TAC limits within CH are 20% in the A season and 3.6% in the B season. In the Aleutian Islands, the TAC limits within CH are 20% in the A season and 48.3% in the B season.
- In the GOA cod fishery: two seasons (A season Jan 20-April 30 at 40% of TAC; B season May 1-November 1 at 60% of TAC) would be established with harvest limits within critical habitat based on best estimates of biomass. Based on these estimates, the TAC limits within CH to start with are 20% in the A season and 31.8% in the B season.

As with Alternatives 1, 2, and 3, the effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and sea lion foraging.

Spatial apportionments under Alternative 5 result in estimated daily average fish removal rates similar to those of Alternatives 3 and 4 for Eastern Bering Sea pollock and Pacific cod (Figure 4.1-5, Figure 4.1-6). Relative to Alternative 1, the removals are evened out over the seasons (Figure 4.1-5). Conversely, they are bimodal with peak removal rates of Atka mackerel Pacific cod, and pollock in spring and autumn from Aleutian Island fishing areas (Figure 4.1-7), though of much lower magnitude (Figure 4.1-8). Compared to other alternatives, estimated daily average removal rates from Aleutian Islands areas are lower during critical spring and summer months than in the other alternatives (Figure 4.1-8). Pacific cod and pollock estimated average daily removal rates in the Gulf of Alaska are most similar to the seasonal distribution of Alternative 4 (Figure 4.1-9), and results in stepwise decreases from winter to summer (Figure 4.1-10).

Alternative 5 also has a series of regional closures and apportionments to reduce spatial fishery concentration. As with other alternatives, an Aleutian Island pollock fishing prohibition may be of marginal benefit to Steller sea lions because pollock are not a key item of Steller sea lion diet west of 170°W longitude (Figure 4.1-11, Figure 4.1-12). Catch limits and multiple seasons within critical habitat reduce the rate at which fish are harvested, though as with the other alternatives, the benefit to Steller sea lions is unclear, given seasonal movements of sea lions among areas, much greater home ranges during winter (see Section 3.1.1.7.2) and the variable amount of foraging occurring inside critical habitat even within a single foraging trip (Figure 4.1-13, Figure 4.1-14).

Alternative 5 measures result in marginally less spatial and temporal concentration of fishery removals of key Steller sea lion prey species than do measures under Alternative 1, and is therefore rated insignificant (Table 4.1-7) under the criteria established for significance in Table 4.1-1. TAC levels are similar to those of the other alternatives except for Alternative 2, and hence the ultimate benefit to the sea lion population may not be as great. Based upon sea lion population trends during 1990-2000, it is assumed that Alternative 5 will not result in a stable population. Thus, changes to the sea lion population would be within 2% of the current trend, and an overall decline would continue at -3.3% to -5.2% per year (Table 4.1-6).

Indirect Effects - Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on Steller sea lions cannot be demonstrated with existing data. Alternative 5 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 10 or 20 nm of 37 rookeries to trawling year-round. It also contains a reduction in TAC of 92% for pollock in the Aleutian Islands (bycatch only), which is an overall reduction of less than 1% for the groundfish TAC for pollock, Pacific cod, and Atka mackerel, resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established in Table 4.1-1, measures which would result in even less disturbance than that which is insignificant are also rated as insignificant (Table 4.1-7).

4.1.1.6 Summary of Effects, Experimental Design Potential, and Re-initiation of Section 7 Consultation for Steller Sea Lions

In conclusion, significance determinations suggests that the effects of the alternatives on Steller sea lion are insignificant for all five alternatives with regard to the questions of incidental take/ entanglement in marine debris, harvest of prey species, and disturbance (Table 4.1-7). On the question for spatial and temporal concentration of the fisheries, Alternative 1 was found to have a conditionally significant negative effect, Alternatives 2 and 3 were found to have a conditionally significant positive effect (Table 4.1-7). Alternatives 3 through 5 generally add additional provisions to spread fisheries harvests over time and areas in an attempt to reduce the likelihood of localized depletions on a broad range (from course to fine) of spatial/temporal scales. These alternative management schemes, in particular Alternatives 2 (Low and Slow) and 4 (Area and Fishery Specific Approach), have reached a fine degree of resolution for which harvests are apportioned among areas, seasons, and gear types. Unfortunately, the resolution at which Steller sea lion and other marine mammal foraging behavior is understood is at much courser temporal and spatial scales than the proposed fishery management measures. Much about the effects determinations remain unknown. Thus analyses involving reductions in TAC, or broad scale seasonal or regional allocations could be more readily evaluated within the context of current understanding of marine mammal foraging and life histories than could effects of small scale (within several nautical miles) or patchwork fishery limits or closures. Alternatives which were rated insignificant for one or more elements do contain measures which would be expected to have some beneficial impacts on localized populations of Steller sea lions however these localized impacts are not expected to be sufficient to reverse of the downward trajectory of the endangered western population of Steller sea lion number and hence were deemed insignificant.

Experimental Design Potential

The management regime proposed in Alternative 3 is similar to that in the NMFS 2000 Biological Opinion (NMFS, 2000a) and the monitoring program suggested therein could be applied to the Alternatives. Because of the reduced level of the sea lion population at present, however, implementation and success of the monitoring scheme may be difficult to gauge. Prior to the 2000 Biological Opinion experimental design, NMFS planned an experiment to test the efficacy of the no-trawl zones. It may be applicable to all the alternatives (NMFS, 1999c). All Steller sea lion fishery management measures include the presumption that fisheries cause reduced prey availability to sea lions or that by manipulation of the fishery, sea lion population trends will be effected. The efficacy of no-trawl zones experiment (NMFS 1999c) includes two studies addressing the possible effects of fishing on prey abundance and distribution. The first study has begun at Seguam Island and will address Atka mackerel issues, and the second study at Kodiak Island is addressing walleye pollock biology. Both studies are designed to determine whether fisheries result in localized depletion of the target fish, and if so, whether or not Steller sea lions may be compromised because of the depletion of prey. Both studies began in the late 1990s and will require five or more years to complete. Some physiological, behavioral, and ecological variants appropriate to measure to demonstrate food limitation, and by inference, localized depletion, are discussed in the study plan.

<u>Re-initiation of Consultation under Section 7 of the ESA is appropriate for the proposed action</u>

Section 402.16(c) requires re-initiation of consultation on an action "if the identified action is subsequently modified in a manner that caused an effect to the listed species or critical habitat that was not considered in the biological opinion..." The NMFS 2000 Biological Opinion was a comprehensive analysis of the BSAI and GOA groundfish fisheries and for all species listed as endangered or threatened. The proposed action, however, contain modifications to fishery management measures for pollock, Pacific cod and Atka mackerel fisheries to protect Steller sea lion that are different than the specific fishery management measures that were analyzed in the 2000 Biological Opinion. Because the determination of what constitutes differences in management measures that may be important to the determination of jeopardy to the listed Steller sea lion or adverse modification of critical habitat is quite subjective, the agency determined re-initiation of consultation is appropriate.

Section 402.16(b) also requires re-initiation of formal consultation "if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered...". Since the 2000 Biological Opinion, new information about Steller sea lion movements based on telemetry studies and new analysis of Steller sea lion scat samples have become available. An examination of that information as it relates to necessary protection measures is warranted.

NMFS recognized consultation under Section 7 of the ESA was appropriate early in this process. The consultation, limited in scope to Alternative 4, proceeded in parallel with preparation of this analysis. The draft Biological Opinion was contained in the draft SEIS (Appendix A). As such, the draft Biological Opinion underwent public review with the draft analysis (see Comments and Response to Comments in Volume III of this final SEIS).

Table 4.1-1 Criteria for determining significance of effects to pinnipeds and sea otters.

Effects	Score					
	S-	CS-	I	CS+	S+	U
Incidental take/ entanglement in marine debris	Take rate increases by >50%	Take rate increases by 25-50%	Level of take below that which would have an effect on population trajectories	NA	NA	Insufficient information available on take rates
Harvest of prey species	Deviation of average daily removal rates is >+251; TAC removals of one or more key prey species increased by more than 5%	Deviation of average daily removal rates is +101 to +250; TAC removals of one or more key prey species increased or reduced from 1998 levels by less than 5%	Deviation of average daily removal rates is ±100; TAC removals of one or more key prey species reduced by 5-20%	Deviation of average daily removal rates is -101 to -250; TAC removals of one or more key prey species reduced from 1998 levels by more than 20%	Deviation of average daily removal rates is <-251; TAC removals of all key prey species (pollock, Pacific cod, Atka mackerel) reduced by more than 20%	Insufficient information available on key prey species
Spatial/ temporal concentration of fishery	Much more temporal and spatial concentration in all key areas	Similar temporal and spatial fishery distribution in some, but not all, key areas	Marginally less temporal and spatial concentration than 1998 fisheries	Much less temporal and spatial concentration in some, but not all key areas	Much less temporal and spatial concentration in all key areas	Insufficient information as to what constitutes a key area
Disturbance	Much more disturbance (all closed areas reopened)	Marginally more disturbance (some closed areas reopened)	Similar level of disturbance as that which was occurring in 1998	NA	NA	Insufficient information as to what constitutes disturbance

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown
NA = Not Applicable
TAC = Total Allowable Catch

Percentages used in determining the significance of effects are given as a plausible a point of departure to initiate discussion as opposed to being deemed statistically meaningful per se. Incidental takes attributed to the fisheries and entanglement in fishing gear and marine debris occur at low levels thought to be insignificant to Steller sea lion populations. The ideal level is undoubtably zero, however even a reduction to zero is considered to be insignificant to pinniped and sea otter populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis. A similar interpretation of significance has been made for disturbance effects on pinnipeds and sea otters. Given that the level of disturbance established for management measures comparable those in effect for 1998 were deemed insignificant, the additional management measures contained in Alternatives 2 through 5 which could result in even less disturbance than that which is insignificant is also deemed insignificant to Steller sea lion populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis. In establishing criteria for rating the significance to pinniped and sea otter populations of management measures affecting the harvest levels to be established for prey species and the temporal and spatial concentrations of harvest NMFS considered management measures resulting in similar levels of TAC removals and similar temporal and spatial patterns of harvest as in 1998 to be conditional significant negative and that to achieve a rating of insignificant marginal reductions in TAC levels or marginal decreases in the concentration temporal and spatial patterns of the fisheries must be reasonably expected to occur as a result of the implementation of the management measures contained in the alternative under consideration. To achieve ratings of conditionally significant positive or significantly positive substantial reductions in TAC levels or substantial decreases in the temporal and spatial concentrations to some or all key prey species and to some or all key pinniped or sea otter foraging areas must be reasonably expected to occur as a result of the implementation of the management measures contained in the alternative under consideration.

Table 4.1-2 Estimated incidental take of Steller sea lions and other marine mammals by commercial pollock, Pacific cod, and Atka mackerel fisheries under each alternative.

		1		2		3		4		5	
Fishery and Area	**Species or Group**	**Mean**	**CI**	**Mean**	**CI**	**Mean**	**CI**	**Mean**	**CI**	**Mean**	**CI**
Eastern Bering Sea Pollock	Steller sea lion	5	3-7	5	3-7	5	3-7	5	3-7	5	3-7
(areas 508 to 530) (Trawl gear only)	All marine mammals	18	15-21	18	15-21	18	15-21	18	15-21	18	15-21
Aleutian Islands Pollock	Steller sea lion	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
(areas 541,542,543) (Trawl gear only)	All marine mammals	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
GOA Pollock (W&C)	Steller sea lion	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
(areas 610,620,630) (All gears)	All marine mammals	3	0-8	1	0-6	2	0-7	3	0-8	3	0-8
Pollock subtotal	Steller sea lion	7	5-9	7	5-9	7	5-9	7	5-9	7	5-9
	All marine mammals	22	16-28	20	14-26	21	15-27	22	16-28	22	16-28
Bering Sea Pacific cod	Steller sea lion	1	0-3	1	0-3	1	0-3	1	0-3	1	0-3
(areas 508 to 530) (All gears)	All marine mammals	3	0-6	2	0-5	3	0-6	3	0-6	3	0-6
Aleutian Islands Pacific cod	Steller sea lion	0	0-1	1	0-2	1	0-2	0	0-1	1	0-2
(areas 541,542,543) (All gears)	All marine mammals	0	0-2	1	0-3	1	0-3	0	0-2	1	0-3
WGOA Pacific cod	Steller sea lion	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
(area 610) (All gears)	All marine mammals	2	0-7	1	0-6	2	0-7	2	0-7	2	0-7
CGOA Pacific cod	Steller sea lion	0	0-0	0	0-0	0	0-0	0	0-0	0	0-0
(areas 620,630) (All gears)	All marine mammals	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
EGOA Pacific cod	Steller sea lion	0	0-0	0	0-0	0	0-0	0	0-0	0	0-0
(area 640) (All gears)	All marine mammals	0	0-0	0	0-0	0	0-0	0	0-0	0	0-0
Pacific cod subtotal	Steller sea lion	2	0-4	3	1-5	3	1-5	2	0-4	3	1-5
	All marine mammals	6	0-12	5	0-11	7	1-13	6	0-12	7	1-13
EBSAI Atka mackerel	Steller sea lion	1	0-3	1	0-3	1	0-3	1	0-3	1	0-3
(Areas 508 to 541) (All gears)	All marine mammals	1	0-4	1	0-4	1	0-4	1	0-4	1	0-4
WAI Atka mackerel	Steller sea lion	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
(Area 543)	All marine mammals	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
CAI Atka mackerel	Steller sea lion	2	1-3	1	0-2	2	1-3	2	1-3	2	1-3
(Area 542)	All marine mammals	2	0-4	1	0-3	2	0-4	2	0-4	2	0-4
Atka mackerel subtotal	Steller sea lion	4	2-6	3	1-5	4	2-6	4	2-6	4	2-6
	All marine mammals	4	0-8	3	0-7	4	0-8	4	0-8	4	0-8
All Fisheries Combined	Steller sea lion	13	10-16	13	10-16	14	11-17	13	10-16	14	11-17
(Areas 508 to 640) (All gears)	All marine mammals	32	23-41	28	19-37	32	23-41	32	23-41	33	24-42
Percentage difference relative to Alternative 1											
All Fisheries Combined	Steller sea lion			0%		8%		0%		8%	
(Areas 508 to 640) (All gears)	All marine mammals			-13%		0%		0%		3%	

Table 4.1-3. Yearly sum of relative mean daily removal rate deviates (deviation difference) based on projected allocations of total allowable catch for each Alternative. Deviates are not additive within columns.

	Alternative				
Fishery and Area	**1**	**2**	**3**	**4**	**5**
Pollock (all areas)	-59	154	-27	-29	-40
Eastern Bering Sea pollock	-91	198	-36	-36	-36
Aleutian Islands pollock	-55	-346	277	470	-346
GOA pollock	118	-120	169	-75	-93
WGOA pollock	96	-128	231	-99	-100
CGOA pollock	133	-114	131	-64	-87
Pacific cod (all areas)	20	-141	-57	202	-23
Bering Sea/AI Pacific cod	-24	-80	-19	152	-29
Aleutian Islands Pacific cod	104	-250	-196	505	-163
GOA Pacific cod	-5	-150	20	24	112
WGOA Pacific cod	17	-144	-30	29	127
CGOA Pacific cod	-19	-154	49	20	102
Atka mackerel (all areas)	149	-65	115	-84	-115
EBSAI Atka mackerel	-103	63	194	-62	-92
WAI Atka mackerel	-41	144	101	-91	-114
CAI Atka mackerel	180	-87	118	-95	-116
All Fisheries and Areas	-15	38	-49	58	-31

Table 4.1-4 Projected total annual catch (TAC) for Eastern Bering Sea, Aleutian Islands, and Gulf of Alaska pollock, Pacific cod, and Atka mackerel by fishery area.

Fishery and Area		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Eastern Bering Sea pollock	TAC (mt)	1,400,000	1,372,290	1,400,000	1,400,000	1,400,000
	Change from Alt. 1 (mt)		-27,710	0	0	0
	Change from Alt. 1 (%)		-2%	0%	0%	0%
Aleutian Islands pollock	TAC (mt)	23,800	2,000	23,800	23,800	2,000
	Change from Alt. 1 (mt)		-21,800	0	0	-21,800
	Change from Alt. 1 (%)		-92%	0%	0%	-92%
GOA pollock Subtotal	TAC (mt)	99,349	44,509	81,882	99,351	99,349
	Change from Alt. 1 (mt)		-54,840	-17,467	2	0
	Change from Alt. 1 (%)		-55%	-18%	0%	0%
WGOA pollock	TAC (mt)	34,474	15,438	29,440	34,460	34,474
	Change from Alt. 1 (mt)		-19,036	-5,034	-14	0
	Change from Alt. 1 (%)		-55%	-15%	0%	0%
CGOA pollock	TAC (mt)	62,391	27,972	50,420	62,437	62,391
	Change from Alt. 1 (mt)		-34,419	-11,971	46	0
	Change from Alt. 1 (%)		-55%	-19%	0%	0%
EGOA pollock	TAC (mt)	2,484	1,099	2,022	2,454	2,484
	Change from Alt. 1 (mt)		-1,385	-462	-30	0
	Change from Alt. 1 (%)		-56%	-19%	-1%	0%
Pollock subtotal	TAC (mt)	1,523,149	1,418,799	1,505,682	1,523,151	1,501,349
	Change from Alt. 1 (mt)		-104,350	-17,467	2	-21,800
	Change from Alt. 1 (%)		-7%	-1%	0%	-1%
Bering Sea/AI Pacific cod	TAC (mt)	188,000	153,652	188,000	188,000	188,000
	Change from Alt. 1 (mt)		-34,348	0	0	0
	Change from Alt. 1 (%)		-18%	0%	0%	0%
GOA Pacific cod subtotal	TAC (mt)	50,848	31,639	50,848	50,848	50,848
	Change from Alt. 1 (mt)		-19,209	0	0	0
	Change from Alt. 1 (%)		-38%	0%	0%	0%
WGOA Pacific cod	TAC (mt)	18,300	11,390	18,300	18,300	18,300
	Change from Alt. 1 (mt)		-6,910	0	0	0
	Change from Alt. 1 (%)		-38%	0%	0%	0%
CGOA Pacific cod	TAC (mt)	28,988	18,034	28,988	28,988	28,988
	Change from Alt. 1 (mt)		-10,954	0	0	0
	Change from Alt. 1 (%)		-38%	0%	0%	0%
EGOA Pacific cod	TAC (mt)	3,560	2,215	3,560	3,560	3,560
	Change from Alt. 1 (mt)		-1,345	0	0	0
	Change from Alt. 1 (%)		-38%	0%	0%	0%
Pacific cod subtotal	TAC (mt)	238,848	185,291	238,848	238,848	238,848
	Change from Alt. 1 (mt)		-53,557	0	0	0
	Change from Alt. 1 (%)		-22%	0%	0%	0%

Table 4.1-4 Continued. Projected total annual catch (TAC) for Eastern Bering Sea, Aleutian Islands, and Gulf of Alaska pollock, Pacific cod, and Atka mackerel by fishery area.

Fishery and Area		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
EBSAI Atka mackerel	TAC (mt)	7,800	4,753	7,800	7,800	7,800
	Change from Alt. 1 (mt)		-3,047	0	0	0
	Change from Alt. 1 (%)		-39%	0%	0%	0%
WAI Atka mackerel	TAC (mt)	27900	16,993	27900	27900	27900
	Change from Alt. 1 (mt)		-10,907	0	0	0
	Change from Alt. 1 (%)		-39%	0%	0%	0%
CAI Atka mackerel	TAC (mt)	33600	20,462	33600	33600	33600
	Change from Alt. 1 (mt)		-13,138	0	0	0
	Change from Alt. 1 (%)		-39%	0%	0%	0%
Atka mackerel subtotal	TAC (mt)	69,300	42,207	69,300	69,300	69,300
	Change from Alt. 1 (mt)		-27,093	0	0	0
	Change from Alt. 1 (%)		-39%	0%	0%	0%
Combined Total	TAC (mt)	1,831,297	1,646,297	1,813,830	1,831,299	1,809,497
	Change from Alt. 1 (mt)		-185,000	-17,467	2	-21,800
	Change from Alt. 1 (%)		-10%	-1%	0%	-1%

Table 4.1-5 Root mean square error (RMSE) index incorporating total allowable catch (TAC) and estimated daily catch rate variability compared to a baseline annual harvest of 1.6% of target species standing biomass. Smaller RMSE values reflect lower TAC or decreased variability of daily catch rate.

	Alternative				
Fishery and Area	**1**	**2**	**3**	**4**	**5**
Eastern Bering Sea Pollock	5,884	3,555	3,961	3,961	3,961
Aleutian Islands Pollock	133	3	68	62	7
Gulf of Alaska Pollock	387	114	396	409	425
Bering Sea and Aleutian Islands Pacific Cod	342	363	503	588	496
Gulf of Alaska Pacific Cod	101	76	171	109	195
Bering Sea and Aleutian Islands Atka Mackerel	25	13	22	21	25
All Fisheries and Areas	6,426	4,099	5,112	4,854	4,921

Table 4.1-6 Intensity of effects categories (harvest of prey species and spatial/temporal concentration) and associated percent increase to population, and new population trends for Steller sea lions.

Intensity of Effect[1]	Observed Percent Annual Change to Population	New Annual Population Trend (r, %/yr)[2]
	12	6.2
	11	5.3
	10	4.3
	9	3.4
	8	2.4
	7	1.5
	6	0.5
Much less	5	-0.4
	4	-1.4
Marginally less	3	-2.3
	2	-3.3
	1	-4.2
Same	**0**	**-5.2**
	-1	-6.1
	-2	-7.1
Marginally more	-3	-8.0
	-4	-9.0
Much more	-5	-9.9
	-6	-10.9
	-7	-11.8
	-8	-12.8
	-9	-13.7
	-10	-14.7

[1] Note: Intensity of effect combined for harvest of prey species and spatial/temporal concentration.
[2] Note: base trend is current overall annual decline rate of -5.18%.

Table 4.1-7 Summary of effects of Alternatives 1 through 5 on Steller sea lion.

Steller Sea Lion	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I	I	I	I	I
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	CS-	CS+	CS+	I	I
Disturbance	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.1.2 Effects on Other ESA Listed Cetaceans (Listed Great Whales)

Seven species of large whales that occur in Alaskan waters are listed under the ESA including: the North Pacific right whale, blue whale, fin whale, sei whale, humpback whale, sperm whale, and bowhead whale. Each proposed alternative will be discussed in terms of four potential effects on these whales: 1) direct (or incidental) take/entanglement in marine debris, 2) harvest of prey species, 3) temporal/spatial concentration of the fishery, and 4) disturbance. Direct interactions with groundfish fishery vessels have been documented between 1989 and 2000 for three of the seven species: fin, humpback, and sperm whales. Several cases of entanglements in marine debris also have been reported for humpback and bowhead whales. Four of the seven species listed consume groundfish as part of their diet: fin, sei, humpback, and sperm whales. Discussions of each potential effect will focus principally on the species noted above.

The criteria for determining significance of effect in this and cetacean species groups is outlined in Table 4.1-7 differs from those developed specifically for pinnipeds and sea otters (Table 4.1-1). The differences are with respect to rating significance and insignificance for the questions of harvest of prey species and spatial/ temporal concentration of fishery.

Direct (or Incidental) Take/Entanglement in Marine Debris

Direct mortalities of endangered whales from entanglement in fishing gear have been observed and reported infrequently in the groundfish fishery. Since 1989, three of the seven listed species have been killed incidental to the fishery. The criteria for determining significance of incidental take (Table 4.1-7) were applied to evaluate level of take for each alternative. Total allowable catch was used to project incidental take within each fishery (Table 4.1-2). A rating of insignificant is, therefore, a take rate that is below that which would have an effect on population trajectories. A rating of conditionally significant negative is a take rate that increases by 25% to 50% the average annual incidental take for the years 1996-2000. A rating of significantly negative is a take rate that increases by more than 50% the average annual incidental take for the years 1996-2000. Increasing take rate significance ratings in increments of 25% are coupled more with scientific uncertainty about knowledge of the actual take rate more than indicating progressively negative degrees of significance (Table 4.1-7). Incidental takes attributed to the fisheries and entanglement in fishing gear and marine debris occur at low levels thought to be insignificant to marine mammal populations. The ideal level is undoubtably zero, however even a reduction to zero is considered to be insignificant to marine mammal populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis. Closures to fishing areas were also considered when evaluating this effect by comparing the portion of takes that occurred within proposed closed areas to total incidental take for the fishery from 1989-1999.

A single fin whale mortality was reported in the GOA pollock trawl fishery operating south of Kodiak Island and Shelikof Strait in autumn 1999. Fin whales were reported in this region year-round, most often in the summer and autumn (POP, 1997). The mortality may have been the result of prey competition, although pollock have not been identified as a key prey species of fin whales in the GOA (see Harvest of Prey Species, next page). Humpback whales are present year-round in Alaska waters but are most frequently reported during the summer and autumn. In 1997, a dead humpback was found entangled in netting and trailing orange buoys near the Bering Strait. It is often difficult to determine if the entanglement occurred with active or derelict gear, or to identify the fishery the derelict gear originated from. Two mortalities (in October 1998 and February 1999) were reported by observers in the BS pollock trawl fishery operating near Unimak Pass. The extent of interactions between bowhead whales and the groundfish fishery are not known. Bowhead whales are present in the Bering Sea during winter and early spring but are usually associated with ice-covered regions. Rope entanglement injuries and deaths as well as ship-strike injuries appear to be rare. Of 236 bowhead whales examined from the Alaskan subsistence harvest (from 1976 to 1992), three had visible ship-strike injuries from unknown sources and six had ropes attached or scars from fishing gear (primarily pot gear), one found dead was entangled in ropes similar to those used with fishing gear in the Bering Sea (Philo *et al.*, 1992). Since 1992, additional bowhead whales have been observed entangled in pot gear or with scars from ropes.[10] Sperm whale interactions with the groundfish fishery have primarily been documented in the GOA longline fishery targeting sablefish in management zones 640 and 650 (Hill *et al.*, 1999). Two of the three entanglements reported between 1997 and 2000 resulted in release of the animal without serious injury. The extent of the injuries to the third animal was not known though it was alive at the time of release.

Harvest of Prey Species

One or more of the target species (pollock, Atka mackerel and Pacific cod) of the GOA and BSAI groundfish fisheries have been identified as prey species of fin, sei, humpback, and sperm whales. To evaluate changes to the harvest of prey for each alternative, significance criteria were developed as described above in Section 4.1 with respect to deviation differences of average daily removal rates, and spanning TAC removals ranging from more than 5% to 20% compared to projected TAC for Alternative 1. Therefore, where removals of one or more key prey species of cetaceans remains the same (within ±5%) as that proposed in past TACs, or the deviation difference was ±100, a rating of insignificant is given. Decreasing and increasing removals of prey species result in significance ratings that are progressively positive and negative, respectively (Table 4.1-8). Sizes of prey species consumed by cetaceans, where available, were also considered when evaluating this effect.

The consumption of pollock by fin whales appears to increase in years where euphausiid and copepod abundance is low (Nemoto, 1957; 1959). Regional variation in diet has also been documented. Pollock consumption was greatest in fin whales occupying shelf waters of the Bering Sea while this prey item was not found in animals in the GOA or western North Pacific Ocean (Kawamura, 1982). Pollock consumed were less than 11.7 in (30 cm) in length, within the size range targeted by the fishery: 5.9- 19.5 in (15-50 cm). Atka mackerel and Pacific cod have also been identified as prey of fin whales though their importance is not known. The diet of sei whales is comprised almost entirely of copepods. Although young mackerel and other small schooling fish were present in a few of the sei whale stomachs sampled in Japan waters, these fish species also prey on copepods and may have been consumed incidentally (Nemoto and Kawamura, 1977). Atka mackerel and walleye pollock are preferred prey species of humpback whales found in waters near the Aleutian Islands (Nemoto, 1959). Atka mackerel consumed were between 5.8-11.7 in (15-30 cm)

[10] J.C. George, "Personal Communication," North Slope Borough, P.O. Box 69, Barrow, AK 99723

in length, and were probably juveniles (adult fish targeted by the fishery usually ranged in size from 14-19 in (35-50 cm; Fritz and Lowe, 1998). Walleye pollock eaten by humpback whales were identified as adults but lengths were not provided (Nemoto, 1959). Other important prey species include euphausiids, herring, anchovy, eulachon, capelin, saffron cod, sand lance, Arctic cod, rockfish, and salmon. Sperm whales feed primarily on mesopelagic squid, however, fish consumption becomes more evident near the continental shelf break and along the Aleutian Islands (Okutani and Nemoto, 1964). Diet composition of sperm whales in the Bering Sea is roughly 70% - 90% squids and 10% - 30% fish which include Atka mackerel, Pacific cod, pollock, salmon, lantern fishes, lancetfish, saffron cod, rockfishes, sablefish, sculpins, lumpsuckers, lamprey, skates, and rattails (Tomilin, 1967; Kawakami, 1980; Rice, 1986a). Pollock do not appear to be a key prey species in any area but have been observed in whales taken in the northwestern Pacific (Kawakami, 1980). The importance of Pacific cod and Atka mackerel to sperm whales is not known (Yang, 1999).

Temporal/Spatial Concentration of Fishery

Proposed changes to the fishery include area closures, season closures, and seasonal allocations of TAC. Temporal and spatial concentration criteria qualitatively rate the significance of the effect of the alternatives on the ESA listed great whales. A rating of insignificant indicates the same temporal and spatial distribution of the fishery, while "marginally" less or more temporal or spatial concentration of the fisheries yields a rating of conditionally significant positive or negative, respectively, and "much" less or more yields a rating of significantly positive or negative, respectively. For those species where prey competition is not evident or changes in TAC are not greater than ±5% under an alternative, increases or decreases in concentrations of fish removals will have an insignificant effect. However, area and season closures may benefit these species by reducing incidental interactions and disturbance.

Disturbance

The effects of disturbance caused by vessel traffic, fishing operations, or underwater noise associated with these activities on baleen whales (North Pacific right, blue, fin, sei, humpback, and bowhead whales) and toothed whales (sperm whales) in the GOA and BSAI are largely unknown. Most baleen whales appear to tolerate or habituate to fishing activity, at least as suggested by their reactions at the surface. Collisions with ships have been a major source of mortality of North Atlantic right whales (Kenney and Kraus, 1993). Blue, fin, and sei whales react strongly by diving or moving away when vessels approach on a direct course or make fast erratic approaches (reviewed in Richardson *et al.*, 1995). Humpback reactions to vessels are highly variable. Observed short-term effects have included avoidance and on rare occasions "charging" at the vessel while long-term effects included abandoning high-use areas (reviewed in Richardson *et al.*, 1995). However, long-term negative effects were not apparent at the population level (Bauer *et al.*, 1993). Bowheads often attempt to outswim vessels, turning perpendicular away from the vessel track only when the ship is about to overtake it. Displacement can be as much as a few kilometers while fleeing (Richardson *et al.*, 1995). When chased, sperm whales often change direction and travel long distances underwater (Lockyer, 1977). However, sperm whales sometimes accompany vessels for extended periods of time when the vessels are operating nonaggressively (e.g., GOA sablefish longline fishery). Reaction to gear, such as pelagic trawls is unknown, although the rarity of incidental takes suggests either partitioning or avoidance. Given their distribution throughout the fishing grounds, at least some individuals may be expected to occasionally avoid contact with vessels or fishing gear, which would constitute a reaction to a disturbance. Assuming these instances occur, the effects are likely temporary.

Vessel noise and the routine use of various sonar devices are audible to whales and may be disturbance sources. When disturbed by vessels: right whales were consistently silent (Watkins, 1986), fin whales continued to vocalize but low-frequency vessel noise often masked social calls (Edds, 1988), and humpbacks tended to be silent when vessels were near (Watkins, 1986). Wintering humpback whales have been observed reacting to sonar pulses by moving away (Maybaum, 1990; 1993). Bowheads stopped calling after bombs were detonated during the Native subsistence harvest.[11] Calling behavior of sperm whales was little affected by boats (Gordon *et al.*, 1992), however, sperm whales sometimes fell silent when they heard acoustic pingers pulsed at low levels, 6-13 kHz (Watkins and Schevill, 1975). The criteria used to describe the disturbance effects of the alternative are qualitative. A rating of insignificant indicates the same level of disturbance, while "marginally" more disturbance results in a rating of conditionally significant negative, and "much" more results in a rating of significantly negative. Given that the level of disturbance established for management measures comparable those in effect for 1998 were deemed insignificant, the additional management measures contained in Alternatives 2 through 5 which could result in even less disturbance than that which is insignificant is also deemed insignificant to marine mammal populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis.

4.1.2.1 Effects of Alternative 1 on ESA Listed Cetaceans

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Under Alternative 1, the take rate for the pollock fishery would not change greater than ±25%, therefore, the intensity of this effect is rated insignificant. Assuming only one Alaska stock of fin whales exists, population level effects would be insignificant. Estimated incidental take rates for the fisheries operating where the humpback whale mortalities occurred (EBS Pollock and EBSAI Mackerel) would not change greater than ±25% under Alternative 1, therefore, the intensity of this effect is rated insignificant (Table 4.1-7). Although take levels are low, the western North Pacific stock numbers below 400 whales and rates of mortality and serious injury cannot be considered insignificant and approaching zero (Angliss *et al.*, 2001). Population level effects are uncertain because it is not known what portion of the western North Pacific stock utilizes these areas and whether gear entangling some whales originated from the U.S. groundfish fishery. Changes to groundfish fishery operations in the Bering Sea would not alter incidental take by more than ±25%, therefore, the intensity of this effect is rated insignificant for bowhead whales. Population level effects would be insignificant given the current increasing trend in abundance of Bering Sea bowhead whales under a managed subsistence harvest. Alternative 1 does not propose changes to the sablefish longline fishery where all incidental takes of sperm whales have occurred, therefore, the intensity of this effect is rated insignificant. Population level effects are uncertain because reliable abundance estimates are not available for the North Pacific stock.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

Assuming pollock represent a key prey species to EBS fin whales, the projected deviation difference of average daily removal rates (see 4.1.1.1 for description) for pollock under this Alternative is -91 (Table 4.1-3), and changes to TAC do not exceed 2% (Table 4.1-4), both resulting in insignificant effects (Table 4.1-8). Bycatch of other fin whale prey (herring, capelin, arctic cod, saffron cod, Pacific cod, Atka mackerel, rockfishes, smelt and salmon) in the Bering Sea Pollock Fishery does not exceed 1% for each of these species

[11] Ibid.

(NMFS unpublished observer data)[12]. Because removals of key prey species do not change greater than ±5%, and the overall deviation difference of relative mean daily removals of pollock is -59 (Table 4.1-3), the intensity of this effect is rated insignificant fin whales. The intensity of this effect is also rated insignificant for sei whales. Under Alternative 1, TAC changes proposed for the Atka mackerel fishery would not be greater than ±5%, and bycatch of Atka mackerel in all other groundfish fisheries is well below 1% of total catch (NMFS unpublished observer data)[13].

Sightings of humpback whales reported in the POP database occurred more frequently in regions utilized by the EBS and GOA pollock fisheries and the BS EAI Atka mackerel fishery (compared to other reported species such as sperm whales, minke whales, killer whales, and Dall's porpoise that were also found in AI pollock and CAI Atka mackerel fishery management zones). Changes proposed for the EBS and GOA Pollock TAC and BS EAI Atka Mackerel TAC are not greater than ±5% for Alternative 1 (Table 4.1-4). Bycatch summaries for other prey species do not exceed 1% except rockfishes (which do not exceed 7% of the total catch). Assuming pollock and Atka mackerel are key prey species of humpback whales, the intensity of this effect is rated insignificant under Alternative 1.

Sperm whales have been observed preying on sablefish caught on commercial longline gear in the GOA (Hill *et al.*, 1999). Bycatch of sablefish for the entire GOA fishery is roughly 7% of total catch (NMFS unpublished observer data).[14] Assuming sablefish are a key prey species of sperm whales in the GOA, removals of this species do not change greater than ±5% and the intensity of this effect is rated insignificant.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

Prey competition is not evident or changes in TAC are not greater than ±5% for fin, sei and sperm whales, therefore, temporal and spatial concentration of fish removals would have an insignificant effect. For humpback whales, where prey competition may be occurring and TAC does change, the extent of prey overlap may be low because these whales appear to be consuming mostly juvenile fish while the fishery is targeting adults. Therefore, any increase or decrease in concentrations of prey removed would not necessarily effect this species at a population level. The intensity of this effect is rated insignificant under Alternative 1.

Indirect Effects - Disturbance Effects (Question 4)

Given the continued occupation of the fishing grounds by these animals, disturbance from vessels and sonar, if it occurs in the BSAI or GOA, does not appear to have population level effects though it may disrupt communication temporarily. The intensity of this effect is rated insignificant (same level of disturbance) under Alternative 1.

[12] D. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.

[13] Ibid.

[14] Ibid.

4.1.2.2 Effects of Alternative 2 on ESA Listed Cetaceans

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates of all marine mammals relative to TAC for all fisheries combined (Table 4.1-2) is -13% under Alternative 2, therefore, the intensity of this effect is rated insignificant (take rate is similar (±25%)). However, under this Alternative, the region where the fin whale mortality occurred would be closed to trawl fishing. While this may benefit fin whales occupying Shelikof Strait it is not known whether these whales represent a distinct segment of the population. Assuming only one Alaska stock exists, population level effects would be insignificant. For humpback whales, area closures to pollock and trawl fishing proposed under Alternatives 2 could potentially reduce interactions (closures include the area where the two mortalities occurred). The significance of this effect may be beneficial for humpback whales given it is not known what portion of the western North Pacific stock utilizes these areas and whether gear entangling some whales originated from the U.S. groundfish fishery. However the potential for reducing takes from a level which has been deemed insignificant in 1998, while desirable, is still rated insignificant (Table 4.1-7). For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for bowhead and sperm whales under Alternatives 2.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

The deviation difference for pollock in the Bering Sea resulted in +198 value (CS-), partly because this Alternative alone proposes seasonal fishing from November to December. Negative values (I to CS+) were calculated in the Aleutian Islands and Gulf of Alaska for pollock and cod. Atka mackerel removals were positive for the EBS/AI and western Aleutian Island (CS-) and insignificant for the central Aleutian. Overall, Alternative 2 had a +38 value (Table 4.1-3), suggesting more fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of +38, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar to all Alternatives.

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for fin whales. For sei whales that occasionally consume Atka mackerel, TAC for the BSAI Atka mackerel fishery is reduced by 67%, but it is unlikely that the TAC changes proposed would effect sei whales at the population level because Atka mackerel do not appear to be key prey for this species, therefore this effect is rated insignificant under Alternative 2. For humpback whales, changes proposed for the EBS pollock TAC are not greater than ±5%, though the GOA pollock fishery TAC would be reduced by 54% and the BS EAI Atka mackerel TAC would be reduced by 67%. The result is an 8% reduction in TAC under Alternative 2 (Table 4.1-4). Deviation differences of summed relative mean daily removal rates (see 4.1.1.1 for explanation) are -120 for GOA pollock, and +63 for EBSAI Atka mackerel (Table 4.1-3), and +154 for the pollock fishery overall and -65 for the overall Atka mackerel fishery. Bycatch summaries for other prey species do not exceed 1% except for rockfishes (which do not exceed 7% of the total catch). Assuming pollock and Atka mackerel are key prey species of humpback whales, the intensity of this effect is rated conditionally significant positive (Table 4.1-8) with respect to TAC (5%-20% reduction in TAC of one or more key prey species) for humpback whales. The significance of this effect is uncertain because it is not known if humpback whales are exclusively consuming groundfish within these fishery management zones or what portion of the central and western Alaska stocks utilize these areas. Thus, the combination of a positive average daily removal rate (deviation difference) resulting in an insignificant rating, and the TAC ranking of CS+ resulted in an overall ranking of insignificant for this Alternative under question 2 for humpback whales. For sperm whales, bycatch of sablefish for the entire GOA fishery is roughly 7% for all Alternatives except Alternative 2, where it increases to a little over 12% (NMFS unpublished observer data)[15]. Assuming sablefish are a key prey species of sperm whales in the GOA, removals of this species do not change greater than ±5% so the intensity of this effect is rated insignificant.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 2.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 2.

4.1.2.3 Effects of Alternative 3 on ESA Listed Cetaceans

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates of all marine mammals relative to TAC for all fisheries combined (Table 4.1-2) do not change under Alternative 3, therefore, the intensity of this effect is rated insignificant (take rate is similar (±25%)). For humpback whales, area closures to pollock and trawl fishing proposed under Alternatives 3 could potentially reduce interactions (closures include the area where the two mortalities occurred). The significance of this effect may be beneficial for humpback whales given it is not known what portion of the western North Pacific stock utilizes these areas and whether gear entangling some whales originated from the U.S. groundfish fishery. However the potential for reducing takes from a level which has been deemed insignificant in 1998, while desirable, is still rated insignificant (Table 4.1-6). For the same reasons listed under Alternative 1, the intensity of this effect would be insignificant for fin, bowhead, and sperm whales under Alternative 3.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For Alternative 3, the deviation difference for pollock in the Bering Sea resulted in -36 (I), but high variability occurred by area with the Aleutian Islands ranking as S-, and all other areas as CS-. Atka mackerel removals under Alternative 3 all resulted in positive values with a CS- ranking for the EBSAI area and insignificant for other areas (Table 4.1-3). Overall, Alternative 3 had a -49 value, suggesting less fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of -49, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar to all Alternatives.

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for fin, sei, and sperm whales under Alternative 3 (Table 4.1-9). For humpback whales changes proposed for the EBS Pollock TAC are not greater than ±5%. However, under Alternative 3, the GOA Pollock Fishery TAC would be reduced by 15%. The result is a 1% reduction in TAC overall under Alternative 3 (calculated from Table 4.1-4). Bycatch summaries for other prey species do not exceed 1% except for rockfishes (which do not exceed 7% of the total catch). Assuming pollock and Atka mackerel are key prey species of humpback

[15] Ibid.

whales, the intensity of this effect is rated conditionally significant positive Table 4.1-9) under Alternative 3 (same removals of one or more key prey species (±5%)) for TAC. Overall however the significance of TAC reductions under Alternative 3 is unknown because it is not known if humpback whales are exclusively consuming groundfish within these fishery management zones or what portion of the central and western Alaska stocks utilize these areas. Combined with the combination of a negative average daily removal rate (deviation difference) resulting in an insignificant rating, and the analyst assigned an overall ranking of insignificant for humpback whales under question 2.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 3.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 3.

4.1.2.4 Effects of Alternative 4 on ESA Listed Cetaceans

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 4.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 4.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 4.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 4.

4.1.2.5 Effects of Alternative 5 on ESA Listed Cetaceans

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates of all marine mammals relative to TAC for all fisheries combined (Table 4.1-2) is +3% under Alternative 5, therefore, the intensity of this effect is rated insignificant (take rate is similar (±25%)). Area closures proposed under Alternative 5 do not include the region where the fin whale mortality occurred. For humpback whales, area closures to pollock and trawl fishing proposed under Alternatives 5 could potentially reduce interactions (closures include the area where the two mortalities occurred). The significance of this effect may be beneficial for humpback whales given it is not known what portion of the western North Pacific stock utilizes these areas and whether gear entangling some whales originated from the U.S. groundfish fishery. However the potential for reducing takes from a level which has been deemed insignificant in 1998, while desirable, is still rated insignificant (Table 4.1-6). For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for bowhead and sperm whales under Alternative 5.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 5.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 5.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 5.

4.1.2.6 Summary of Effects and Re-initiation of Section 7 Consultation on ESA Listed Cetaceans

The criteria for determining significance of effect in this and other cetacean species groups presented below in Table 4.1-8 differs from those developed specifically for pinnipeds and sea otters (Table 4.1-1). The differences are with respect to rating significance and insignificance for the questions of harvest of prey species and spatial/ temporal concentration of fishery. Harvest levels of prey species and the temporal and spatial concentration of fisheries with levels and patterns similar to those of 1998 are considered to have insignificant effects on cetacean populations in consideration of these species life histories, dependence upon pollock, Pacific cod, and Atka mackerel as prey species, and foraging behavior (Sections 3.1.2 and 3.1.3).

Table 4.1-8 Criteria for determining significance of effects to cetaceans.

Effects	Score					
	S-	CS-	I	CS+	S+	U
Incidental take/ entanglement in marine debris	Take rate increases by >50%	Take rate increases by 25-50%	Level of take below that which would have an effect on population trajectories	NA	NA	Insufficient information available on take rates
Harvest of prey species	TAC removals of one or more key prey species increased by more than 20%; Deviation of average daily removal rates is >+251	TAC removals of one or more key prey species increased by 5%- 20%; Deviation of average daily removal rates is +100 to +250	TAC removals of prey species equivalent to 1998 harvests (within 5% + or -); Deviation of average daily removal rates is ±100	TAC removals of one or more key prey species reduced by 5%-20%; Deviation of average daily removal rates is -100 to -250	TAC removals of all key prey species (pollock, Pacific cod, Atka mackerel) reduced by more than 20%; Deviation of average daily removal rates is <-251	Insufficient information available on key prey species
Spatial/ temporal concentration of fishery	Much more temporal and spatial concentration in all key areas	Marginally more temporal and spatial concentration than 1998 fisheries	Similar temporal and spatial fishery distribution as in 1998 fisheries	Much less temporal and spatial concentration in some, but not all key areas	Much less temporal and spatial concentration in all key areas	Insufficient information as to what constitutes a key area
Disturbance	Much more disturbance (all closed areas reopened)	Marginally more disturbance (some closed areas reopened)	Similar level of disturbance as that which was occurring in 1998	NA	NA	Insufficient information as to what constitutes disturbance

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown
NA = Not Applicable
TAC = Total Allowable Catch

Percentages used in determining the significance of effects are given as a plausible a point of departure to initiate discussion as opposed to being deemed statistically meaningful per se. Incidental takes attributed to the fisheries and entanglement in fishing gear and marine debris occur at low levels thought to be insignificant to marine mammal populations. The ideal level is undoubtably zero, however even a reduction to zero is considered to be insignificant to marine mammal populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis. A similar interpretation of significance has been made for disturbance effects on marine mammals. Given that the level of disturbance established for management measures comparable those in effect for 1998 were deemed insignificant (4.1.2.1), the additional management measures contained in Alternatives 2 through 5 which could result in even less disturbance than that which is insignificant is also deemed insignificant to marine mammal populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to these analyses.

Table 4.1-9 Summary of effects of Alternatives 1 through 5 on ESA listed cetaceans.

ESA Listed Cetaceans	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I	I	I	I	I
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	I	I	I	I	I
Disturbance	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

In all cases, the direct and indirect effects are expected to have insignificant effects on listed great whales (Table 4.1-9). There was some consideration that reduced harvests may be beneficial to humpback whales by reducing incidental takes under Alternatives 2, 3, and 5, which close certain areas to fishing, but that would assume that the incidental takes that are occurring are affecting only the smaller western North Pacific stock of humpback whales. Identifying mortalities to stock (i.e., conducting genetic tests on biopsy samples and/or photo-identification) would resolve whether takes are occurring in the western stock or in the central stock. The effects of incidental take on the central stock would be insignificant at the population level given current estimates of abundance (about 4,000 whales) and that the stock appears to be increasing (Angliss *et al.*, 2001). However the potential for reducing takes of humpback whales from a level which has been deemed insignificant in 1998, while desirable, is still rated insignificant (Table 4.1-7).

<u>Re-initiation of Consultation under Section 7 of the ESA is unnecessary</u>

Effects were evaluated to determine if a need to reinitiate formal consultation, pursuant to Section 7 of the ESA would be necessary as a result of any of the alternatives. None of the alternatives are expected to negatively effect ESA listed cetaceans by an increase in incidental take. Critical habitat has not been designated for ESA listed cetaceans. In addition, no new information has become available since or alternative actions modified in a manner not previously considered by the NMFS (2000a) Biological Opinion that would be expected to change the conclusion that no adverse effect to ESA listed cetaceans will result from any of the alternatives. Consequently, re-initiation of ESA Section 7 consultation is not necessary for ESA listed cetaceans.

4.1.3 Effects on Other Cetaceans Besides ESA Listed Species

Ten species of whales and dolphins occur in Alaskan waters and are protected under the MMPA (but not listed under the ESA) including: the gray whale, minke whale, beluga whale, killer whale, Pacific white-sided dolphin, harbor porpoise, Dall’s porpoise and beaked whales (Baird’s, Cuvier’s and Stejneger’s). Each proposed alternative will be discussed in terms of four potential effects on these cetaceans: 1) direct (or incidental) take/entanglement in marine debris, 2) harvest of prey species, 3) temporal/spatial concentration of the fishery, and 4) disturbance. To date, direct interactions with groundfish fishery vessels have been documented between 1989 and 2000 for five of the ten species: minke whales, killer whales, Pacific white-sided dolphins, harbor porpoise, and Dall’s porpoise. Several cases of entanglements in marine debris also have been reported for gray whales. Five of the ten species listed consume groundfish as part of their diet:

minke whales, killer whales, Pacific white-sided dolphins, harbor porpoise, and Dall's porpoise. Discussions of effects will focus principally on these species.

The criteria for determining significance of effect in this and other cetacean species groups presented in Table 4.1-8.

Direct (or Incidental) Take/Entanglement in Marine Debris

Direct mortalities of five species from entanglement in fishing gear have been observed and reported in the groundfish fishery since 1989. The criteria for determining significance of incidental take (Table 4.1-6) were applied to evaluate level of take for each alternative. Total allowable catch was used to project incidental take within each fishery (Table 4.1-2). A rating of insignificant is, therefore, a take rate that is below that which would have an effect on population trajectories. A rating of conditionally significant negative is a take rate that increases by 25% to 50% the average annual incidental take for the years 1996-2000. A rating of significantly negative is a take rate that increases by more than 50% the average annual incidental take for the years 1996-2000. Increasing take rate significance ratings in increments of 25% are coupled more with scientific uncertainty about knowledge of the actual take rate more than indicating progressively negative degrees of significance (Table 4.1-8). Incidental takes attributed to the fisheries and entanglement in fishing gear and marine debris occur at low levels thought to be insignificant to marine mammal populations. The ideal level is undoubtably zero, however even a reduction to zero is considered to be insignificant to marine mammal populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis. Closures to fishing areas were also considered when evaluating this effect by comparing the portion of takes that occurred within proposed closed areas to total incidental take for the fishery from 1989-1999.

A single minke whale mortality was reported in the BS/GOA joint-venture trawl fishery (predecessor of the current fishery) in 1989. Ten years later, a single minke whale mortality was reported in the BS pollock trawl fishery operating in the eastern Bering Sea in autumn 1999. Minke whales are reported in this region year-round, most often in the summer (POP, 1997). Killer whale mortalities are second only to Dall's porpoise in the groundfish fishery. The majority of takes reported between 1989 and 1999 occurred in the BS trawl fishery (8 deaths) followed by the BS longline (2 deaths) and GOA longline (1 death) fisheries. Two mortalities of Pacific white-sided dolphins have been reported in the EBS pollock groundfish fishery. One in the trawl fishery in the spring of 1992, the other in the longline fishery during the winter of 1995. These dolphins are present in Alaska waters year-round although sightings are reported with greater frequency during the summer (POP, 1997). Four harbor porpoise mortalities were reported in the EBS trawl fishery between 1994 and 1997. Although harbor porpoise occur year-round in coastal and shelf waters of the AI, BS and GOA, mortalities occurred in all seasons except winter. The highest incidental take rate for any cetacean is that of Dall's porpoise. Most mortalities reported between 1989 and 2000 occurred in the BS trawl fishery (1 injury and 45 deaths) followed by the BS longline (3 deaths), GOA trawl (3 deaths), and BS jig (1 injury) fisheries. The extent of interactions between gray whales and the groundfish fishery are not known. Rope entanglement injuries and deaths as well as ship-strike injuries appear to be rare. Since 1997, five entanglements (mostly in pot gear) and one ship strike mortality have been reported in Alaska waters.

Harvest of Prey Species

One or more of the target species (pollock, Atka mackerel and Pacific cod) of the GOA and BSAI groundfish fisheries have been identified as prey species of minke whales, killer whales, Pacific white-sided dolphins, harbor porpoise, and Dall's porpoise. To evaluate changes to the harvest of prey for each alternative, significance criteria were developed to span TAC removals ranging from more than 5% to 20% compared to projected TAC for Alternative 1. Therefore, where removals of one or more key prey species of cetaceans remains the same (within ±5%) as that proposed in past TACs, a rating of insignificant is given. Decreasing and increasing removals of prey species (Table 4.1-1) result in significance ratings that are progressively positive and negative, respectively (Table 4.1-8). Sizes of prey species consumed by cetaceans, where available, were also considered when evaluating this effect.

Prey preferences of eastern North Pacific minke whales are not known but may be inferred from western North Pacific studies (Kasamatsu and Tanaka, 1992; Tamura *et al.*, 1998). Pelagic schooling fishes (in particular herring, walleye pollock, mackerel, anchovy, and saury) make up over 90% of the total prey weight ingested. Other important prey include sand lance, capelin, saffron cod, Arctic cod, crustaceans, and small quantities of squid. The stomach of a minke whale stranded in the Aleutian Islands contained walleye pollock ranging in size from 4.6 to 6.8 in. (11.8 to 17.5 cm), on the low end of the size range targeted by the fisheries: 5.8-19.5 in (15-50 cm). Killer whales consume a wide variety of prey including fish, birds and other marine mammals (Jefferson *et al.*, 1991). Walleye pollock has not been identified as prey of killer whales, however, the ranges of these species overlap in areas where both are abundant. Atka mackerel were consumed by killer whales caught in the coastal waters off Japan, but importance of the species to killer whales was unknown (Yang, 1999). Where interactions with experimental longline groundfish fisheries have been observed, killer whales preyed upon sablefish, Greenland turbot, arrowtooth flounder and Pacific halibut while ignoring other species of fish available to them such as Pacific cod, grenadier, rockfish, walleye pollock, and shortspine thornyhead (Yano and Dahlheim, 1995). Pacific white-sided dolphin prey varies relative to sampling location. In pelagic populations in the north Pacific and off the coast of northern Japan, fish prey included lanternfish, deep-sea smelt, and *Argentina* sp., and squid (Walker and Jones, 1993). In coastal regions, preferred prey include northern anchovy, Pacific hake, Pacific herring, capelin and squid, and to a lesser extent, pollock, rockfish, mackerel, smelt, saury, eulachon, and sanddab (Walker *et al.*, 1986; Morton, 2000). Harbor porpoise prey studies have not been conducted in Alaska. However, prey studies in Washington and British Columbia found their diet included cephalopods and a wide variety of fish, including Pacific herring, smelt, eelpout, eulachon, pollock, Pacific sand lance, and gadids (Gearin *et al.*, 1994; Walker *et al.*, 1998). Most porpoise appeared to feed on juvenile, possibly even larval gadids (e.g., tomcod and hake) as estimated by the relative size of otoliths. The diet of Dall's porpoise in Alaska waters is principally cephalopods and fish (including Pacific herring, salmon, capelin, deep-sea smelt, lanternfish, walleye pollock, Arctic cod, eelpout, Pacific sand lance, rockfish, sablefish, Atka mackerel, and flatfish). Commercially important fish species were present in only small amount in animals taken in the North Pacific Ocean (e.g., pollock only occurred in 8 of 272 stomachs examined) (Crawford, 1981). Walleye pollock ranged in size from 1.6 to 5.8 in. (4-15 cm), on the low end of the size range targeted by the fisheries: 5.8-19.5 in (15-50 cm).

Temporal/Spatial Concentration of Fishery

Proposed changes to the fishery include area closures, season closures, and seasonal allocations of TAC. Temporal and spatial concentration criteria qualitatively score the fishery. A rating of insignificant indicates the same temporal and spatial distribution of the fishery, while "marginally" less or more temporal or spatial concentration of the fisheries yields a rating of conditionally significant positive or negative, respectively, and "much" less or more yields a rating of significantly positive or negative, respectively. For those species where prey competition is not evident or changes in TAC are not greater than ±5% under an alternative, increases or decreases in concentrations of fish removals will have an insignificant effect. However, area and season closures may benefit these species by reducing incidental interactions and disturbance.

Disturbance

The effects of disturbance caused by vessel traffic, fishing operations, or underwater noise associated with these activities on baleen (gray and minke whales) and toothed (beluga, killer whale, Pacific white-sided dolphin, harbor porpoise, Dall's porpoise and beaked whales) whales in the GOA and BSAI are largely unknown. Migrating gray whales sometimes exhale underwater, expose their blowholes only to inhale (termed "snorkeling"), and change course when disturbed by vessels (reviewed in Richardson *et al.*, 1995). Conversely, gray whales will sometimes approach idling or slow moving vessels. Similarly, minke whales generally do not approach and sometimes avoid vessels that are underway (Palka and Hammond, 2001), but may swim toward and under stationary or slow-moving vessels (Leatherwood *et al.*, 1982; Tillman and Donovan, 1986). Reactions by belugas to vessels largely depends on boat type and operation, and whale activity and experience. These whales abandoned summering areas only for short periods when disturbed (even when the disturbance was hunting boats) and at times would interact with vessels (reviewed in Richardson *et al.*, 1995). Killer whales, Pacific white-sided dolphins, Dall's porpoise and beaked whales sometimes accompany vessels for extended periods of time. In some cases, vessel attraction was so intense that it comprised estimates of abundance for Pacific white-sided dolphins (Buckland *et al.*, 1993) and Dall's porpoise (Turnock and Quinn, 1991). Conversely, harbor porpoise tend to avoid vessels (Taylor and Dawson, 1984; Palka and Hammond, 2001). Reaction to gear, such as pelagic trawls is unknown, although the rarity of incidental takes suggests either partitioning or avoidance. Given their distribution throughout the fishing grounds, at least some individuals may be expected to occasionally avoid contact with vessels or fishing gear, which would constitute a reaction to a disturbance. Assuming these instances occur, the effects are likely temporary.

Vessel noise and the routine use of various sonar devices are audible to whales and may be disturbance sources. Calling behavior in gray whales changed to reduce masking by boat noise (Dahlheim 1987). Higher-frequency motor noise was found to mask minke whale sounds (reviewed in Richardson *et al.*, 1995). High-frequency components of vessel noise were found to modify pod integrity, surfacing and diving behavior, and call types of belugas (Cosens and Dueck 1993), while propeller cavitation noise form icebreakers was predicted to mask beluga calls within 8-38 nm (14-71 km) of the ship (Erbe and Farmer, 2000). Most shipping noise is below the hearing thresholds of the smaller odontocetes (sensitivity is usually above 10 kHz: Dotinga and Oude Elferink, 2000), and for most cetaceans, repeated exposure to sound sources led to habituation (Richardson *et al.*, 1995).

Bottom trawls on the eastern Bering Sea shelf operate during the summer when most of the eastern North Pacific stock of gray whales forages in that area. The question then arises, does the bottom trawling activity affect the availably of benthic prey, an important food source for gray whales? The criteria used to describe the disturbance effects of the alternative are qualitative. A rating of insignificant indicates the same level of disturbance, while "marginally" more disturbance results in a rating of conditionally significant negative, and "much" more results in a rating of significantly negative. Given that the level of disturbance established for management measures comparable those in effect for 1998 were deemed insignificant (citation ?), the additional management measures contained in Alternatives 2 through 5 which could result in even less disturbance than that which is insignificant is also deemed insignificant to marine mammal populations.

Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis.

4.1.3.1 Effects of Alternative 1 on Other Cetaceans Besides ESA Listed Species

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Minke whale mortalities may have been the result of prey competition (see Harvest of Prey Species below) because these whales appear to avoid vessels in northern waters (Palka and Hammond, 2001), though this behavior has not been reported in Alaska waters. Under Alternative 1, the take rate for the pollock fishery would not change greater than ±25%, therefore, the intensity is rated insignificant. Area closures to pollock and trawl fishing do not apply to the region where the mortality occurred in 1999. Population level effects are uncertain because abundance estimates are available for only a small part of this stocks range and "home ranges" have not been determined. However, takes have been reported infrequently (once every ten years), therefore, the effect of take on minke whales is insignificant.

Incidental take rates of all marine mammals relative to TAC for the BS fishery (pollock, Pacific cod, and Atka mackerel) (Table 4.1-2) do not change by more than -5%, therefore, the intensity of this effect is rated insignificant (take rate is similar (±25%)) under Alternative 1. For killer whales, fishery interactions, at least with longline vessels, appear to be a function of attraction to the vessel in order to consume non-target species rather than direct prey competition. Population level effects are uncertain because it is unknown whether this behavior is pod specific, in which case one mortality per year could potentially diminish pod viability. For these reasons the effect on killer whales of Alternative 1, and all other alternatives considered, is unknown (Table 4.1-10). The effect of take on Pacific white-sided dolphins is insignificant. Although population level effects are uncertain because abundance estimates are not available for the Bering Sea, takes have been reported only two times in the past 10 years. Because harbor porpoise in northern waters appear to avoid vessels (Taylor and Dawson, 1984; Palka and Hammond, 2001), mortalities may have been the result of prey competition (see Harvest of Prey Species below). However, current abundance estimates show even if prey competition is occurring, population level effects would be insignificant. Vessel attraction behavior rather than prey competition appears to be a factor in interactions between the fisheries and Dall's porpoise. Overestimates of abundance of this stock may be as high as fivefold because of vessel attraction behavior (Turnock and Quinn, 1991). The effects of incidental take on Dall's porpoise would be insignificant at the population level given current estimates of abundance. The extent of interactions between gray whales and the groundfish fishery are not known, however, population level effects would be insignificant given the current increasing trend in abundance of eastern North Pacific gray whales and recovery of this stock from endangered status under the ESA.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

Assuming pollock are a key prey species of minke whales and harbor porpoise, changes proposed for the Pollock TAC are not greater than ±5%, so the intensity of the effect is rated insignificant under Alternative 1. Pollock consumed by these species are usually smaller (larval and juvenile fish) than those targeted by the fishery. As described in section 4.1.1.1 and elsewhere, the deviation difference for mean daily removal rates of the overall pollock fishery is -59 (Table 4.1-3), and insignificant effect (Table 4.1-9).

Where interactions with experimental longline groundfish fisheries have been observed, killer whales preyed upon sablefish, Greenland turbot, arrowtooth flounder and Pacific halibut while ignoring other species of fish available to them such as Pacific cod, grenadier, rockfish, walleye pollock, and shortspine thornyhead

(Yano and Dahlheim, 1995). Fishery interactions in this case appear to be more a function of attraction to fishery vessels in order to consume non-target species rather than direct prey competition. Assuming sablefish, turbot, flounder, and halibut are key prey, bycatch of these species in the groundfish fisheries do not exceed 5% of the total catch (NMFS unpublished observer data). Therefore, the intensity of this effect is rated insignificant for killer whales (same removals of one or more key prey species (±5%)).

Key prey species of Pacific white-sided dolphins and Dall's porpoise include cephalopods and small schooling fishes. Fishery interactions in the case of Dall's porpoise may be more a function of attraction to vessels rather than direct prey competition. Bycatch of these fish species do not exceed 1% of the total catch (NMFS unpublished observer data). The intensity of this effect is rated insignificant under Alternative 1 (same removals of one or more key prey species (±5%)).

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)
Prey competition is not evident or changes in TAC are not greater than ±5% for killer whales, Pacific white-sided dolphins, and Dall's porpoise, therefore, temporal and spatial concentration of fish removals will have an insignificant effect. For minke whales and harbor porpoise, where prey competition may be occurring and TAC does change, the extent of prey overlap may be low because these cetaceans appear to be consuming mostly larval and juvenile fish while the fishery is targeting adults. Therefore, any increase or decrease in concentrations of prey removed would not necessarily effect these species at a population level. The intensity of this effect is rated insignificant under Alternative 1.

Indirect Effects - Disturbance Effects (Question 4)

Given the continued occupation of the fishing grounds by these animals, disturbance from vessels and sonar, if it occurs in the BSAI or GOA, does not appear to have population level effects though it may disrupt communication temporarily. The relationship between gray whales and bottom trawling is unclear, although population level impacts do not appear to have occurred in light of this stocks having nearly fully recovered (Rugh *et al.*, 1999) coincident with decades of bottom trawling on the eastern Bering Sea shelf. The intensity of this effect is rated insignificant (same level of disturbance) under Alternative 1.

4.1.3.2 Effects of Alternative 2 on Other Cetaceans Besides ESA Listed Species

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates of all marine mammals relative to TAC for all fisheries combined (Table 4.1-2) is -13% under Alternative 2, therefore, the intensity of this effect is rated insignificant (take rate is similar (±25%)). However, under this alternative, closure areas may reduce some of the incidental takes of killer whales and Dall's porpoise in the BSAI fisheries. Of the 11 killer whale deaths reported, 73% occurred in areas proposed for closure. For Dall's porpoise, roughly 45% of deaths that occurred between 1989 and 1999 (24 out of 53) occurred within areas slated for closure. However, if killer whales and Dall's porpoise are attracted to vessels they may follow the fishery outside these areas. The significance of this effect may be beneficial for killer whales because it is not known whether this behavior is pod specific and occurring only within those areas proposed for closure. Overall, the effect on killer whales under Alternative 2 is unknown (Table 4.1-10). The effects of incidental take on Dall's porpoise would be insignificant at the population level given current estimates of abundance. These closure areas do not extend to the locations where minke whale and Pacific white-sided dolphin mortalities took place. Harbor porpoise mortalities would be reduced by half (from 4 to 2 deaths) but the effects of take would be insignificant at the population level given current estimates of abundance.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for killer whales, Pacific white-sided dolphins, and Dall's porpoise under Alternative 2. Assuming pollock are a key prey species of minke whales and harbor porpoise, changes proposed for the EBS Pollock TAC are not greater than ±5%. However, the AI Pollock Fishery TAC and the GOA Pollock Fishery TAC would be reduced by 92% and 54%, respectively, under Alternative 2. The result is a 7% reduction in TAC for all pollock fisheries combined (calculated from Table 4.1-4). Bycatch summaries for the other prey species listed do not exceed 1% of total catch. The intensity of this effect may be beneficial for minke whales under Alternative 2 (5%-20% reduction in TAC of one or more key prey species). It is not known if minke whales are exclusively consuming pollock within these fishery management zones or if these areas constitute "home ranges" for this whale stock. However, minke whales appear to be consuming pollock that are smaller than that targeted by the fishery therefore the effect on minke whales under Alternative 2 is rated insignificant. For harbor porpoise, population level effects are considered insignificant given their current abundance in the GOA and BS and that they appear to consume larval and juvenile fish not targeted by the fishery.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 2.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 2.

4.1.3.3 Effects of Alternative 3 on Other Cetaceans Besides ESA Listed Species

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates of all marine mammals relative to TAC for all fisheries combined (Table 4.1-2) do not change under Alternative 3, therefore, the intensity of this effect is rated insignificant (take rate is similar (±25%)). However, under this Alternative, closure areas may reduce some of the incidental takes of killer whales and Dall's porpoise in the BSAI fisheries. Of the 11 killer whale deaths reported, 55% occurred in areas proposed for closure. For Dall's porpoise, roughly 28% of deaths that occurred between 1989 and 1999 occurred within areas slated for closure. However, if killer whales and Dall's porpoise are attracted to vessels they may follow the fishery outside these areas. The significance of this effect may be beneficial for killer whales because it is not known whether this behavior is pod specific and occurring only within those areas proposed for closure. Overall, the effect on killer whales under Alternative 3 is unknown (Table 4.1-10). The effects of incidental take on Dall's porpoise would be insignificant at the population level given current estimates of abundance. These closure areas do not extend to the locations of minke whale and Pacific white-sided dolphin mortalities. Harbor porpoise mortalities would be reduced by half (from 4 deaths to 1) but the effects of take would be insignificant at the population level given current estimates of abundance.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for killer whales, Pacific white-sided dolphins, and Dall's porpoise under Alternative 3. Assuming pollock are a key prey species of minke whales and harbor porpoise, changes proposed for the EBS Pollock TAC are not greater than ±5%, and as described in section 4.1.1.1 and elsewhere, the deviation difference of relative mean daily removal rate is -36 (I). However, the GOA Pollock Fishery TAC would be reduced by 15% under Alternative 3. The result is a 1% reduction in TAC for all pollock fisheries combined (calculated from Table 4.1-4), though on a daily removals basis this is insignificant (-27, Table 4.1-3). Bycatch summaries for the other prey species listed do not exceed 1% of total catch. The intensity of this effect is rated insignificant (same removals of one or more key prey species [±5%]) for minke whales and harbor porpoise under Alternative 3.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 3.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 3.

4.1.3.4 Effects of Alternative 4 on Other Cetaceans Besides ESA Listed Species

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 4 except for killer whales which is unknown (Table 4.1-10).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 4.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 4.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 4.

4.1.3.5 Effects of Alternative 5 on Other Cetaceans Besides ESA Listed Species

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates of all marine mammals relative to TAC for all fisheries combined (Table 4.1-2) is +3% under Alternative 5, therefore, the intensity of this effect is rated insignificant (take rate is similar (±25%)). However, under this alternative, closure areas may reduce some of the incidental takes of killer whales and Dall's porpoise in the BSAI fisheries. Of the 11 killer whale deaths reported, 36% occurred in areas proposed for closure. For Dall's porpoise, roughly 11% of deaths that occurred between 1989 and 1999 occurred within areas slated for closure. However, if killer whales and Dall's porpoise are attracted to vessels they may follow the fishery outside these areas. The significance of this effect may be beneficial for killer whales because it is not known whether this behavior is pod specific and occurring only within those areas proposed for closure. Overall, the effect on killer whales under Alternative 3 is unknown (Table 4.1-10). The effects of incidental take on Dall's porpoise would be insignificant at the population level given current estimates of abundance. These closure areas do not extend to the locations of minke whale and Pacific white-sided dolphin mortalities. Harbor porpoise mortalities would be reduced by half (from 4 deaths to 1) but the effects of take would be insignificant at the population level given current estimates of abundance.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for killer whales, Pacific white-sided dolphins, and Dall's porpoise under Alternative 5. Assuming pollock are a key prey species of minke whales and harbor porpoise, changes proposed for the EBS Pollock TAC are not greater than ±5%. However, the AI Pollock Fishery TAC would be reduced by 92% under Alternative 5. The result is a 1% reduction in TAC for all pollock fisheries combined (calculated from Table 4.1-4). Bycatch summaries for the other prey species listed do not exceed 1% of total catch. The intensity of this effect is rated insignificant (same removals of one or more key prey species (±5%)) for minke whales and harbor porpoise under Alternative 5.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 5.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 5.

4.1.3.6 Summary of Effects on Other Cetaceans Besides ESA Listed Species

The criteria for determining significance of effect in this and other cetacean species groups presented in Table 4.1-8.

Table 4.1-10 Summary of effects of Alternatives 1 through 5 on other cetaceans besides the ESA listed species.

Unlisted cetaceans	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I (U for killer whales)	I (U for killer whales)	I (U for killer whales)	I (U for killer whales)	I (U for killer whales)
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	I	I	I	I	I
Disturbance	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

In all cases, the direct and indirect effects are expected to have insignificant effects on cetaceans (Tables 4.1-7, 4.1-9). The case that differs is the effects of incidental take on killer whales which are unknown for all alternatives. The consideration that the effect may be beneficial for alternatives that close certain areas to fishing assumes that the incidental takes would occur within the same pods and thus affect pod viability. Identifying mortalities to pod, and conducting photo-identification studies of killer whales associating with fishing vessels, would resolve whether takes are occurring in only one pod or from many pods. However the potential for reducing takes of killers whales is unknown.

4.1.4 Effects of the Alternatives on Northern Fur Seals

As with other apex predators such as Steller sea lions, ecological interactions between northern fur seals and the groundfish fisheries are caused by spatial and temporal overlap between fur seal foraging areas and groundfish fisheries and from competition for target and bycatch species taken by the fisheries. The diet of northern fur seals includes a wide range of fish species, with less apparent dependence on Pacific cod and Atka mackerel compared to Steller sea lions (Section 3.4). However, both adult and juvenile pollock occur in the diet of northern fur seals and consumption rates vary according to the abundance of different age classes of pollock in the foraging environment (Swartzman and Haar, 1983; Sinclair *et al.,* 1996). Evaluation of the indirect effects of fisheries on northern fur seals, stemming from the various alternatives, therefore, focuses less on removals of Pacific cod and Atka mackerel and more broadly on removals of pollock and small schooling fishes.

Northern fur seals forage at shallow to mid-water depths of 0 to 820 ft (0-250 m), both near shore and in pelagic regions of their migratory range. Female and young male fur seals generally consume juvenile and small-sized (2 to 8 inch) schooling fishes and squids although diet varies across oceanographic subregions along their migration routes and around breeding locations in the Pribilof Islands. In the eastern Bering Sea, primary prey species include pollock and Pacific cod, but deep sea smelts, lanternfish, and squids are also major components. Recent studies based on scat analysis have indicated that the pollock and Pacific cod consumed by fur seals tend to be smaller than those selected by the target fisheries, however data from stomach collections from the 1960s through the 1980s indicate that fur seals often consume adult pollock. Recent studies used bio-chemical methods to study the diet of northern fur seals suggests that the diet of deep diving fur seals in waters over the continental shelf includes adult pollock (Kurle and Worthy, 2000; Goebel, 2001). Thus, the most relevant indirect effects of the alternatives on northern fur seals are likely to be those that either increase or decrease the abundance or distribution of smaller schooling fishes and squid, or shift the overall pattern of pollock and Pacific cod harvest in a manner that changes the harvest rate of fur seal prey.

The alternatives are discussed below in terms of four potential effects: 1) direct effects (incidental take or entanglement in marine debris), 2) fisheries harvest of prey species, 3) temporal and spatial concentration of the fishery, and 4) disturbance effects. The criteria used for determining the significance of effects on northern fur seals is outlined in Table 4.1-1.

4.1.4.1 Effects of Alternative 1 on Northern Fur Seals

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of northern fur seals is uncommon in the groundfish fisheries. The last recorded mortality in any Alaskan groundfish fishery occurred in 1996, when the take rate was one animal per 1,862,573 mt of groundfish harvested. Observer records from 1990 to 1999 indicate that direct interactions with groundfish vessels occurred only in the BSAI trawl fishery, despite observer placement in pot, longline and trawl fisheries in both the BSAI and GOA. In the BSAI trawl fishery, the average annual take rate (1994 to 1998) was 1.4. This level of take contributes little to the northern fur seal potential biological take (PBR) of 18,244 (Ferrero *et al.,* 2000) and is inconsequential to population trends.

Northern fur seal entanglement in marine debris is more common than any other species of marine mammal in Alaskan waters (Laist, 1987, 1997; Fowler, 1987). Fowler (1987) concluded that mortality of northern fur seals from entanglement in marine debris contributed significantly to declining trends in the Pribilof Islands during mid to late 1970s and early 1980s. Laist (1997) suggested that modest signs of northern fur seal population recovery in recent years may be an indication that entanglement in net debris is among the factors impeding population recovery. As noted earlier in Section 4.1.1 Annex V of the MARPOL statute prohibits the discard of plastics, including net debris. The contribution of intentional discard of net debris from Alaskan groundfish fisheries vessels is thought to have declined over the past decade. However, consistent numbers of seals entangled in packing bands on St. Paul Island may reflect disposal of these materials in proximity to the islands. Recent data from satellite-tracked drifters deployed in the Bering Sea suggests a "trapped" circulation pattern around the Pribilof Islands (Stabeno *et al.,* 1999) which may retain marine debris in the nearshore environment. An increase in the number of Antarctic fur seals (*Arctocephalus gazella*) entangled in polypropylene packing bands was observed at Bird Island, South Georgia, in the late 1980s as these materials came into common usage by at-sea processing vessels (Croxall *et al.,* 1990).

Involuntary sources of marine debris, as in loss of gear, are diminishing as fishery cooperative systems develop (such as in the BSAI offshore pollock allocation). That is, as the pace of fisheries is slowed, there is less incentive to risk capital equipment.[16] Data do not yet exist to assess the rates at which various gear types are lost or discarded to result in risk to fur seals, especially in regard to fishery or nation of origin. In

[16] Jim Coe, "Personal Communication," AFSC, 7600 Sand Point Way NE, Seattle, WA 98115.

consideration of progress in stemming the loss and discard of net fragments and other plastic debris by domestic commercial fisheries, the extent to which the current FMP, or any alternatives to it, could change the rate of fur seal entanglement in marine debris is considered to be low. There seem to be few alternatives, given the likelihood that sources beyond the control of fisheries managers (i.e., foreign fisheries, international shipping, and shoreside refuse) constitute significant sources of discard. In view of these factors, the effects on northern fur seals under Alternative 1 are considered insignificant, with respect to incidental take and entanglement in marine debris on northern fur seals.

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Management actions under the current BSAI and GOA FMPs, specific to the protection of northern fur seals, have not been addressed directly. Trawl closures around the Pribilof Islands, established mainly for the protection of crab stocks, may offer positive benefits for fur seals by limiting prey removals in waters surrounding the Pribilof Island rookeries. However, only northern fur seals foraging close to the islands would benefit by the availability of an undisturbed prey field and recent tracking studies show that foraging trips of both adult female and juvenile male fur seals extend well beyond the trawl closure boundaries. Furthermore, the partitioning of foraging habitat by lactating fur seals on the Pribilof Islands (Figure 3.1.4-1) indicates that the Pribilof Islands Area Habitat Conservation Zone would primarily benefit females from northeast St. Paul Island and provide less protection to the foraging habitat of females from southwest St. Paul Island or St. George Island.

The Alternative 1 measures result in the removal of northern fur seal forage. The size of the fish removed and whether the bycatch of squid, small schooling fish, pollock, and Pacific cod are a large fraction of their estimated biomass in the Bering Sea must be considered in determining if the harvest could have significant effects on the population. Catches of squid and small schooling fish (e.g., fish designated in the forage fish assemblage) in the groundfish fisheries of the BSAI and GOA are low, generally less than 1,000 mt per year. While precise biomass estimates for these groups do not exist, the exploitation rate on these groups in the groundfish fisheries is also thought to be very low. For instance, squid biomass in the Bering Sea may be as large as 4 million mt, based on marine mammal food habits, daily ration, and abundance data (Sobolevsky, 1996). Similarly, with respect to small schooling fishes, consumption of capelin in the Gulf of Alaska by arrowtooth flounder alone may be as large as 300,000 mt per year (Livingston, 1994). Assuming that these crude projections of squid and capelin biomass at least approximate the order of magnitude of the true population levels, then the fisheries removals would amount to only a fraction of 1 percent of those populations.

Fisheries for pollock do not target fish younger than 3 years of age (Ianelli *et al.,* 1999; Dorn *et al.,* 1999; Thompson and Dorn, 1999; Thompson and Zenger, 1994; Fritz, 1996). The overall catch of pollock smaller than 30 cm is small, and thought to be only 1 to 4 percent of the number of one- and two-year olds each year in the eastern Bering Sea and GOA (Fritz, 1996). However spatial and temporal patterns in the bycatch of juvenile pollock in the Bering Sea may influence the rate of removals in areas where northern fur seals forage. Exploitation rates of 2-3 year old pollock ranged between 11% and 21% from 1973 to 1979 during the period when the foreign fishery in the eastern Bering Sea operated northwest and west of the Pribilof Islands (Fritz, 1996). Seasonally, the highest bycatch of small pollock occurs during early summer (May-July) when spawning aggregations have dispersed and pollock are generally less segregated by size (Fritz, 1996). Data on the consumption rate of adult pollock by northern fur seals is inconclusive. Analysis of data from stomach collections (e.g., Swartzman and Haar, 1983; Sinclair *et al.,* 1994) indicate that fur seals may consume adult pollock when it is available in the foraging environment , whereas studies based on scat analysis show a diet consisting of primarily of juvenile pollock (e.g. Sinclair *et al.,* 1996; Antonelis *et al.,* 1997). Carbon and nitrogen isotope analysis of fur seal tissues suggests that the diet of lactating females includes prey at trophic levels equivalent to 2 - 4 year-old walleye pollock and small Pacific herring during the fall (Kurle and Worthy, 2000). Fatty acid analysis of milk samples from lactating fur seals consistently diving to depths greater than 328 ft (100 m) in outer continental shelf waters of the Bering Sea had fatty acid signatures most similar to fatty acid signatures of walleye pollock. In waters over the continental shelf, adult walleye pollock are generally found near the bottom while juvenile pollock are usually concentrated in the surface layer above the thermocline (Bailey, 1989) suggesting that the diet of deep diving fur seals in these areas includes adult pollock.

Therefore, while fisheries do harvest prey of northern fur seals (i.e., pollock and Pacific cod), competition due to the harvest rates of those species may vary depending on the size range consumed by fur seals. The overall catch of juvenile pollock has tended to be low in recent years and the degree to which adult pollock occur in the northern fur seal diet is not certain. While the potential overlap with fisheries may be moderated by these factors, effects on northern fur seals may yet exist, the relevance of which is not reflected by estimates of biomass removals over large geographical areas. However, NMFS considers Alternative 1 to have insignificant effects on northern fur seals, as the case for such effects may be weaker than the case for Steller sea lions.

<u>Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)</u>

The competitive overlap between fisheries for Pacific cod and pollock and northern fur seals is influenced by several factors determining whether removals are concentrated in space or time. First, to the degree that the size of fish targeted by the fishery is greater than that generally eaten by fur seals, competition may vary depending on the availability of smaller prey in foraging areas. Second, under Alternative 1, 45% of the catch from both fisheries occurs during the A season in winter when female and juvenile male fur seals are not commonly found in the areas used by fisheries in the Bering Sea or the GOA. Third, during the summer, fishery harvest rates on adult pollock and Pacific cod in areas used by fur seals are below the annual target rates for the fish stocks as a whole (NMFS, 2000c). For instance, in the eastern Bering Sea west of 170°W, pollock harvest rates in the summer have averaged less than 5% since the early 1980s (environmental assessment for pollock RPAs). Pacific cod harvest rates in the same area and time have been less than 1% since 1996. Fourth, under Alternative 1, the summer pollock fishery in the Bering Sea begins on September 1, which reduces the temporal overlap between the pollock fishery and the fur seal breeding season (June-October). These features of fisheries under Alternative 1 suggest that the intensity of their interactions with northern fur seals may not be as pronounced as it appears to be with Steller sea lions.

While these factors lower the probability of adverse impacts stemming from spatial or temporal concentration of fisheries in northern fur seal foraging areas, changes in harvesting activity and/or concentration of harvesting activity in space and time may differentially impact fur seal foraging habitat at both the population and sub-population level. For example, the proportions of total June-October pollock catch in fur seal foraging habitat (defined as the combined meta-home ranges for females from St. Paul and St. George islands; Figure 3.1.4-1) increased from an average of 40% in 1995-1998 to 69% in 1999-2000 (Figure 4.1-1). The shift in the distribution of fishing effort is due in part to trawl closures to protect Steller sea lion foraging habitat implemented during 1999 and 2000; the proportion of pollock catch in Steller sea lion critical habitat decreased from an average of 44% to 16% in the same period. Increases in the catch of eastern Bering Sea pollock may represent potential increases in competition, because pollock represents 34% to 80% of northern fur seal diet in the Bering Sea. Increased catches of other prey items such as Pacific cod, Atka mackerel, and rockfish may be of less consequence, because they comprise less than 5 % of fur seal diet. From 1995-99 the proportion of the summer pollock catch removed from the meta-home range of lactating fur seals from

St. George Island was consistently higher than the catch in foraging areas used by St. Paul Island females (Figure 4.1-1). The smaller size of the population in conjunction with a higher rate of decline in pup production on St. George Island in recent decades suggests that the impact of the pollock fishery in this area on the foraging habitat of St. George Island females should be considered. Given the uncertainty in the degree to which fur seals compete with the fishery for adult pollock in fur seal foraging areas where spatial and temporal overlap has been identified, it is assumed that conditionally significant negative effects could occur.

Indirect Effects – Disturbance Effects (Question 4)

The potential for disturbance effects caused by vessel traffic, fishing gear, or noise appears limited for northern fur seals. Kajimura (in Johnson *et al.,* 1989) reported no response by fur seals when approached by ship, and NMFS observers on board Japanese driftnet vessels regularly reported fur seals in close proximity to both the gear and fishing vessels (International North Pacific Fisheries Commission [INPFC] reports from the 1980s). Interactions with other types of fishing gear, such as trawl nets, also appear limited based on the rare incidence of takes in groundfish fisheries. Thus, the measures under Alternative 1 are consistent with efforts to avoid these kinds disturbance effects on northern fur seals.

Disturbance effects on northern fur seal prey are difficult to identify. Fisheries in the Bering Sea do occur in areas used by foraging northern fur seals, and their prey are represented as both target species (e.g., pollock) and bycatch species. The same principle for assessing prey disturbance effects as developed for Steller sea lions is, therefore, applied here as well. If harvesting activity or concentration of that harvesting activity in space and time change relative to Alternative 1, then the effects on northern fur seals, if any, may be altered. For example, the proportion of hours trawled in June-October catch in combined fur seal female foraging habitat increased from an average of 40% in 1995-1998 to 65% in 1999-2000 (Figure 4.1-2). The proportion of hours trawled in Steller sea lion critical habitat decreased from an average 58% to 20% in the same period. Similar to the spatial distribution of pollock catch discussed above, the number of hours trawled in the area where lactating fur seals from St. George Island forage was consistently higher in 1995-2000 than the hours trawled in foraging areas used by St. Paul Island females (Figure 4.1-2). The Pribilof Island trawl closure provides some constraints on fishing activity in areas where northern fur seals forage, however as discussed above, habitat partitioning between breeding groups and the distance at which fur seals forage from the islands reduce the effectiveness of the trawl closure. The variability of potential disturbance effects among years and between breeding groups on each island suggests that the intensity of disturbance is not well known and that the disturbance effect under Alternative 1 (and all other alternatives considered) is unknown (Table 4.1-9).

4.1.4.2 Effects of Alternative 2 on Northern Fur Seals

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of northern fur seals in the groundfish fisheries under Alternative 2 is expected to mirror rates under Alternative 1. Mortality in fishing gear would remain a rare event. TAC reductions under Alternative 2 would not have a meaningful effect on the existing low mortality rate of less than 1 northern fur seal per 1.5 million mt of groundfish harvested. As noted in Section 4.1.4.1, domestic fisheries contributions to northern fur seal entanglement in discarded net debris are not likely to have population level effects, despite ongoing debate about the effects of marine debris from all sources, including those beyond the control of fisheries management. Alternative 2 is not expected to alter the circumstances existing under

Alternative 1. As such, both alternatives are consistent with the goal of limiting direct effects and such, both alternatives are rated as insignificant (Table 4.1-11).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 2 reduces the catch of pollock and Pacific cod in Steller sea lion foraging habitat, and thus the gross amount of target and bycatch species caught will be lower than under Alternative 1. However, closure of the Steller sea lion Conservation Area will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands during the fur seal breeding season. Figure 4.1-3 shows the location of trawls in the 2000 C and D season EBS pollock fishery relative to the 1998 B season. Although the overall levels of northern fur seal prey removals classified as bycatch in commercial fisheries are very low, the increase of total catch occurring in fur seal foraging habitat due to the redistribution of fishing effort away from Steller sea lion critical habitat will likely increase the bycatch of juvenile pollock, forage fish and squid in northern fur seal foraging habitat. The bycatch of juvenile pollock is typically highest during the summer season in the outer shelf domain when spawning aggregations are dispersed and adult and juvenile pollock are found in the same areas northwest and west of the Pribilof Islands (Fritz, 1996). Current diet information is not sufficient to assess the degree to which fur seals compete with the fishery for adult pollock, but the intensity of competition will logically increase as more fishing occurs in fur seal foraging areas. While the overall extent that removals of pollock and Pacific cod are reduced under Alternative 2, the probable increase in the fisheries harvest of prey species consumed by northern fur seals in the eastern Bering Sea is rated as insignificant (Table 4.1-11).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

Recent satellite telemetry data on the foraging locations of northern fur seals allows for analysis of fur seal foraging locations at finer scales of resolution. While Alternative 2 reduces the catch of pollock and Pacific cod in Steller sea lion foraging areas and thus resembles the critical habitat protections implemented during the 2000 summer fishery in the Bering Sea, it results in an increase in the harvest rate on these species in areas where fur seals forage. The proportion of total June-October catch in fur seal meta-home ranges increased from 47% in 1998 to 64% in 2000. Relative to Alternative 1 (which represents regulations for the 1998 pollock fishery), this reflects a change in the impact on northern fur seal foraging habitat. Alternative 2 also expands the timing of the fishery from only September and October to the entire season when fur seals are breeding on the Pribilof Islands (June -October). While this change slows the pace of the fishery; it may also increase the likelihood of localized effects due to the concentration of the fishery in fur seal foraging habitat. In addition to the possibility of increased bycatch of fur seal prey species during the breeding season, any overlap in the size of groundfish taken by the fishery and fur seals will be exacerbated by temporal shifts in catch distribution and may substantially change the level of interactions.

Areas closed to fishing in the eastern Bering Sea under Alternative 2 include habitat used by foraging fur seal females breeding on the Pribilof Islands. This includes the waters north of Unimak Pass and on the shelf to the east of the Islands in the Pribilof Islands Conservation Area . While catches of fur seal prey will be lower in these areas, Alternative 2 does not account for the biomass of the target species in the area closed to fishing. This could increase harvest rates in areas open to the fishery relative to Alternative 1. For fur seals, this effect will depend on the degree of overlap in the size of fish taken by fur seals and fisheries. Given that Alternative 2 differs from Alternative 1 and represents probable increases in the spatial and temporal interactions of the groundfish fisheries with northern fur seals, it is rated as conditionally significant negative (Table 4.1-11).

Indirect Effects – Disturbance Effects (Question 4)

Alternative 2 is not expected to result in new forms of disturbance however it may intensify those previously discussed under Alternative 1. The critical habitat protections implemented during the 2000 summer fishery in the Bering Sea, resulted in an increase in the number of hours trawled in areas where fur seals forage. Coincident with the increased pollock catch in fur seal foraging habitat resulting from critical habitat protections for Steller sea lions, the proportion of hours trawled during June-October in fur seal meta-home ranges increased from 42% in 1998 to 63% in 2000. Relative to Alternative 1, it is reasonable to assume that the level the level of disturbance due to the activity of fishing vessels will increase in northern fur seal foraging habitat if similar area closures are implemented under Alternative 2. As with Question 3, the expansion of the timing of the fishery under Alternative 2 from September-October to the entire season when fur seals are breeding on the Pribilof Islands (June - October) will increase the disturbance in fur seal foraging habitat. While this change may slow the pace of the fishery; it may also increase the likelihood of localized effects due to the concentration of the fishery in fur seal foraging habitat. Although Alternative 2 may increase the disturbance to the fur seal prey field relative to Alternative 1, its effect on the disturbance of northern fur seals is unknown (Table 4.1-11).

4.1.4.3 Effects of Alternative 3 on Northern Fur Seals

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of northern fur seals in the groundfish fisheries under Alternative 3 is expected to mirror rates under Alternative 1. The anticipated changes in harvest rates or fisheries distributions would not affect the very low rate of northern fur seal incidental take. Mortality in fishing gear would remain a rare event. As noted in Section 4.1.4.1, domestic fisheries contributions to northern fur seal entanglement in discarded net debris is not likely to have population level effects despite the ongoing debate about the effects of marine debris from all sources, including those beyond the control of fisheries management. Alternative 3 is not expected to alter the circumstances existing under Alternative 1. Thus, the effects relating to direct takes and entanglement in derelict fishing gear under Alternative 3 is rated insignificant (Table 4.1-11). Alternative 3 is consistent with the underlying protection goal with reference to limiting direct effects.

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

As with Alternative 2, closure of RPA Areas (Area 8 and 9) under Alternative 3 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands during the fur seal breeding season. The percentage of the TAC occurring during the C/D seasons will increase to 60% from 55% during the B season under Alternative 1. The increase of total catch occurring in fur seal foraging habitat due to the redistribution of fishing effort away from Steller sea lion critical habitat described under Alternative 2 will likely increase the bycatch of juvenile pollock, forage fish and squid in northern fur seal foraging habitat. In addition, the shift in the beginning of the fishery from September 1 to June 1 will increase competition during the fur seal breeding season. The bycatch of juvenile pollock is typically highest during the summer season in the outer shelf domain when spawning aggregations are dispersed and adult and juvenile pollock are found in the same areas northwest and west of the Pribilof Islands (Fritz, 1996). Current diet information is not sufficient to assess the degree to which fur seals compete with the fishery for adult pollock, however both recent fatty acid and stable isotope analyses of fur seal diets in addition to historical data based on stomach sampling indicate that fur seals consume adult pollock. The intensity of competition will logically increase as more fishing occurs in fur seal foraging areas. However, the magnitude of the competition is not expected to have population level effects and Alternative 3 is rated as insignificant (Table 4.1-9).

Indirect Effects – Spatial and Temporal Concentration on Fishery (Question 3)

Alternative 3 also reduces the catch of pollock and Pacific cod in Steller sea lion foraging areas and with the exception of opening Area 7 to fishing, resembles the critical habitat protections implemented during the 2000 summer fishery in the Bering Sea. In 2000, the shift in fishing effort relative to the 1998 fishery caused an increase the harvest rate on prey species in areas where fur seals forage. As stated above, the proportion of total June-October catch in fur seal meta-home ranges increased from 47% in 1998 to 64% in 2000, indicating a possible change in the impact on northern fur seal foraging habitat under Alternative 3. Increased temporal overlap may also occur as the timing of the fishery changes from only September and October to the entire season when fur seals are breeding on the Pribilof Islands (June -October). While this change slows the pace of the fishery; it may also increase the likelihood of localized effects due to the concentration of the fishery in fur seal foraging habitat. In addition to the possibility of increased bycatch of fur seal prey species during the breeding season, any overlap in the size of groundfish taken by the fishery and fur seals will be exacerbated by temporal shifts in catch distribution.

As discussed under Alternative 2, areas closed to fishing in the eastern Bering Sea under Alternative 3 include habitat used by foraging fur seal females breeding on the Pribilof Islands. This includes the waters north of Unimak Pass in the CVOA and SSL Conservation Area and in the Pribilof Islands Conservation Area, as well as 20 nm closures around the Pribilof islands. While catches of fur seal prey will be lower in these areas, Alternative 3 does not account for the biomass of the target species in the area closed to fishing. This could increase harvest rates in areas open to the fishery relative to Alternative 1. For fur seals, this effect will depend on the degree of overlap in the size of fish taken by fur seals and fisheries. Given that Alternative 3 will likely increase in the spatial and temporal interactions of the groundfish fisheries with northern fur seals relative to Alternative 1, it was rated as conditionally significant negative (Table 4.1-11).

Indirect Effects – Disturbance Effects (Question 4)

The spatial and temporal overlap of the fishery and northern fur seal foraging habitat resulting from the closure of Area 8 in the CVOA and Area 7 in the SSL Conservation Area under Alternative 3 will result in an increase in the number of hours trawled in areas where fur seals forage. Relative to Alternative 1, it is reasonable to assume that the level the level of disturbance due to the activity of fishing vessels will increase in northern fur seal foraging habitat if area closures are implemented under Alternative 3. Similar to Question 3, the expansion of the timing of the fishery under Alternative 2 from September-October to the entire season when fur seals are breeding on the Pribilof Islands (June -October) will increase the duration of the disturbance in fur seal foraging habitat. Although Alternative 3 may increase the disturbance to the fur seal prey field relative to Alternative 1, its effect is unknown (Table 4.1-11).

4.1.4.4 Effects of Alternative 4 on Northern Fur Seals

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of northern fur seals in the groundfish fisheries under Alternative 4 is expected to mirror rates under Alternative 1. The anticipated changes in harvest rates or fisheries distributions would not affect the very low rate of northern fur seal incidental take. Mortality in fishing gear would remain a rare event. As noted in Section 4.1.4.1, domestic fisheries contributions to northern fur seal entanglement in discarded net debris is not likely to have population level effects despite ongoing debate about the effects of marine debris from all sources, including those beyond the control of fisheries management. Alternative 4 is not expected to alter the circumstances existing under Alternative 1. Thus, the effects related to direct takes and entanglement in derelict fishing gear under Alternative 4 are insignificant (Table 4.1-11). The alternative is consistent with the underlying protection goal with reference to limiting direct effects.

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 4 represents little change in the harvest of fur seal prey species relative to Alternative 1. Under Alternative 4 increased competition for prey species in fur seal foraging habitat will occur from the seasonal shift in the timing of the fishery (September and October under Alternative 1 to June -October under Alternative 4). The division of the Alternative 1 fall fishery into two seasons with equal allocations will likely slow the pace of the fishery, thus reducing the intensity of competition. However, seasonally, the highest bycatch of small pollock occurs during early summer (May-July) when spawning aggregations have dispersed and pollock are generally less segregated by size (Fritz, 1996). However, the magnitude of increased bycatch of fur seal prey species during the breeding season due temporal shifts in catch distribution is not expected to effect the fur seal population as a whole, Alternative 4 is rated as insignificant (Table 4.1-11).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

Under Alternative 4 only the Sea Lion Conservation Area will be closed to trawling for pollock and catcher-processors will be excluded from the CVOA from June 10 to December 31. This will shift the spatial distribution of the fishery into fur seal foraging habitat to some degree, however it is difficult to predict whether increased competition will occur due to the harvest of prey species. From 1999 to 2000 the pollock catch occurring in the foraging habitat of St. George Island females dropped from 44.7% 28.4%, while fishing in the foraging area of northeast St. Paul increased from 21% to 34% during the same period (Figure 4.1-1). The shift in fishing distribution reflects the closure of Areas 7 and 8 during the 2000 pollock fishery and illustrates the potential for varying degrees of competition between the foraging areas of fur seals from each island. As with Alternatives 2,3 and 5, Alternative 4 expands the timing of the fishery from only September and October (Alternative 1) to the entire season when fur seals are breeding on the Pribilof Islands (June -October). While this change slows the pace of the fishery; it may also increase the likelihood of localized effects between foraging areas. Given the uncertainty of the effect of increased fishing in fur seal habitat during June-August, the effects of Alternative 4 are rated as conditionally significant negative (Table 4.1-11).

Indirect Effects – Disturbance Effects (Question 4)

The disturbance effects under Alternative 4 mirror the possible effects resulting from the spatial and temporal concentration of the fishery discussed in the previous section. Figure 4.1-2 shows the decrease of 13.6% in hours trawled in the foraging area of St. George Island females from 1999 to 2000 while hours trawled in the foraging area of northeast St. Paul increased 19% during the same period. Given the uncertainty regarding the potential disturbance to the fur seal prey field of increased fishing in fur seal habitat during June-August, in addition to variability in the effects of on different foraging areas, the effects on the disturbance of northern fur seals under Alternative 4 is unknown (Table 4.1-11).

4.1.4.5 Effects of Alternative 5 on Northern Fur Seals

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of northern fur seals in the groundfish fisheries under Alternative 5 is expected to mirror rates under Alternative 1. The anticipated changes in harvest rates or fisheries distributions would not affect the very low rate of northern fur seal incidental take. Mortality in fishing gear would remain a rare event. As noted in Section 4.1.4.1, domestic fisheries contributions to northern fur seal entanglement in discarded net debris are not likely to have population level effects despite ongoing debate about the effects of marine debris from all sources, including those beyond the control of fisheries management. Alternative 5 is not expected to alter the circumstances existing under Alternative 1. Thus, the effects relating to direct takes and entanglement in derelict fishing gear are rated insignificant (Table 4.1-9). Alternative 4 is consistent with the underlying protection goal with reference to limiting direct effects .

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 5 is derived from the suite of RPA measures that were in place for the 2000 pollock and Atka mackerel fisheries. It limits the amount of catch within Steller sea lion critical habitat to be in proportion to estimated fish biomass. To the extent that fishing effort is displaced from the Steller sea lion Conservation Area, Alternative 5 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands during the fur seal breeding season. The probable effect is indicated by the location of trawls in the 2000 C and D season EBS pollock fishery relative to fishery relative to the 1998 B season (Figure 4.1-3). Although the overall levels of northern fur seal prey removals classified as bycatch in commercial fisheries are very low, the increase of total catch occurring in fur seal foraging habitat due to the redistribution of fishing effort away from Steller sea lion critical habitat will likely increase the bycatch of juvenile pollock, forage fish and squid in northern fur seal foraging habitat. As with Alternatives 2-4, Alternative 5 also expands the timing of the fishery from only September and October to June -October when fur seals are breeding on the Pribilof Islands and the bycatch of juvenile pollock is typically highest in the outer shelf domain (Fritz, 1996). Similarly, to the degree to which fur seals compete with the fishery for adult pollock, the intensity of competition will may increase as more fishing occurs in fur seal foraging areas. However, the magnitude of the competition is not expected to have population level effects and Alternative 3 is rated as insignificant (Table 4.1-9).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

The implementation of the RPA measures during the 2000 summer fishery in the Bering Sea, increased the proportion of total June-October catch in fur seal meta-home ranges from 47% in 1998 to 64% in 2000. Relative to Alternative 1 (which represents regulations for the 1998 pollock fishery), this reflects a change in the impact on northern fur seal foraging habitat. Alternative 5 also expands the timing of the fishery from only September and October to cover the entire season when fur seals are breeding on the Pribilof Islands (June -October). Alternative 5 allows fishing in critical habitat in proportion to the estimated fish biomass and may result in less overlap outside of areas closed to fishing. As discussed above, for fur seals, this effect will depend on the degree of overlap in the size of fish taken by fur seals and fisheries. However, given that Alternative 5 differs from Alternative 1 representing probable increases in the spatial and temporal interactions of the groundfish fisheries with northern fur seals, it is rated as conditionally significant negative (Table 4.1-11).

Indirect Effects – Disturbance Effects (Question 4)

The RPA measures implemented during the 2000 summer fishery in the Bering Sea, resulted in an increase in the number of hours trawled in areas where fur seals forage. The increased pollock catch in fur seal foraging habitat resulting from RPA measures implemented to protect Steller sea lion habitat resulted in an increase in the proportion of hours trawled during June-October in fur seal meta-home ranges from 42% in 1998 to 63% in 2000. Relative to Alternative 1, it is reasonable to assume that the level the level of disturbance due to the activity of fishing vessels will increase in northern fur seal foraging habitat if similar area closures are implemented under Alternative 5. As discussed for Alternatives 2-4, changes in the timing of the fishery under Alternative 5 will increase the period of disturbance in fur seal foraging habitat to cover the entire breeding season (June-October). Although Alternative 5 may increase the disturbance to the fur seal prey field relative to Alternative 1, its effect is unknown (Table 4.1-11).

4.1.4.6 Summary of Effects on Northern Fur Seals

The criteria used for determining the significance of effects on northern fur seals under Alternatives 1 through 5 is outlined in Table 4.1-1. Table 4.1-11 summarizes the effects under Alternatives 1 through 5 on northern fur seals.

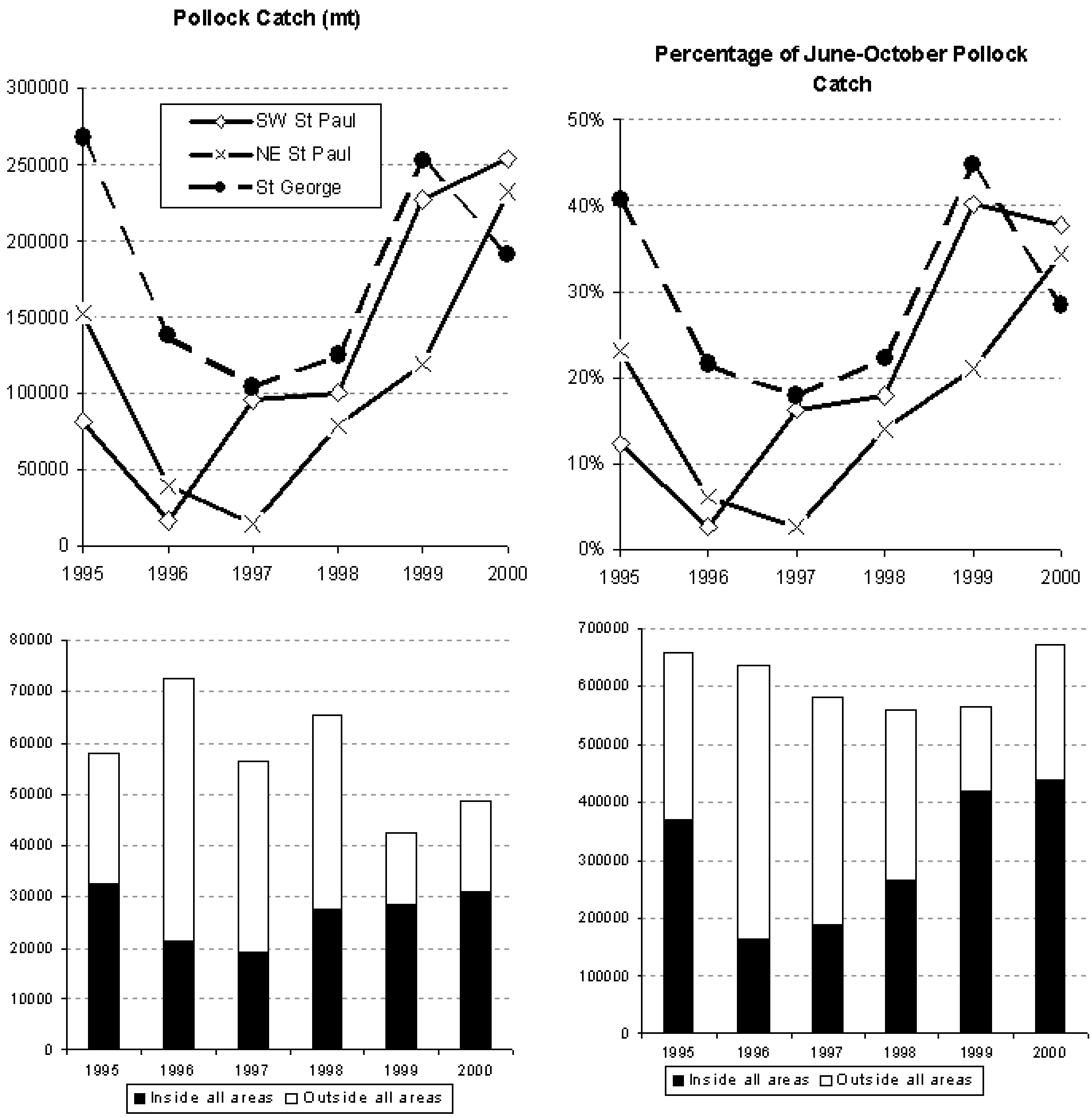
Table 4.1-11 Summary of effects of Alternatives 1 through 5 on northern fur seals.

Northern Fur Seals	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I	I	I	I	I
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	CS-	CS-	CS-	CS-	CS-
Disturbance	U	U	U	U	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

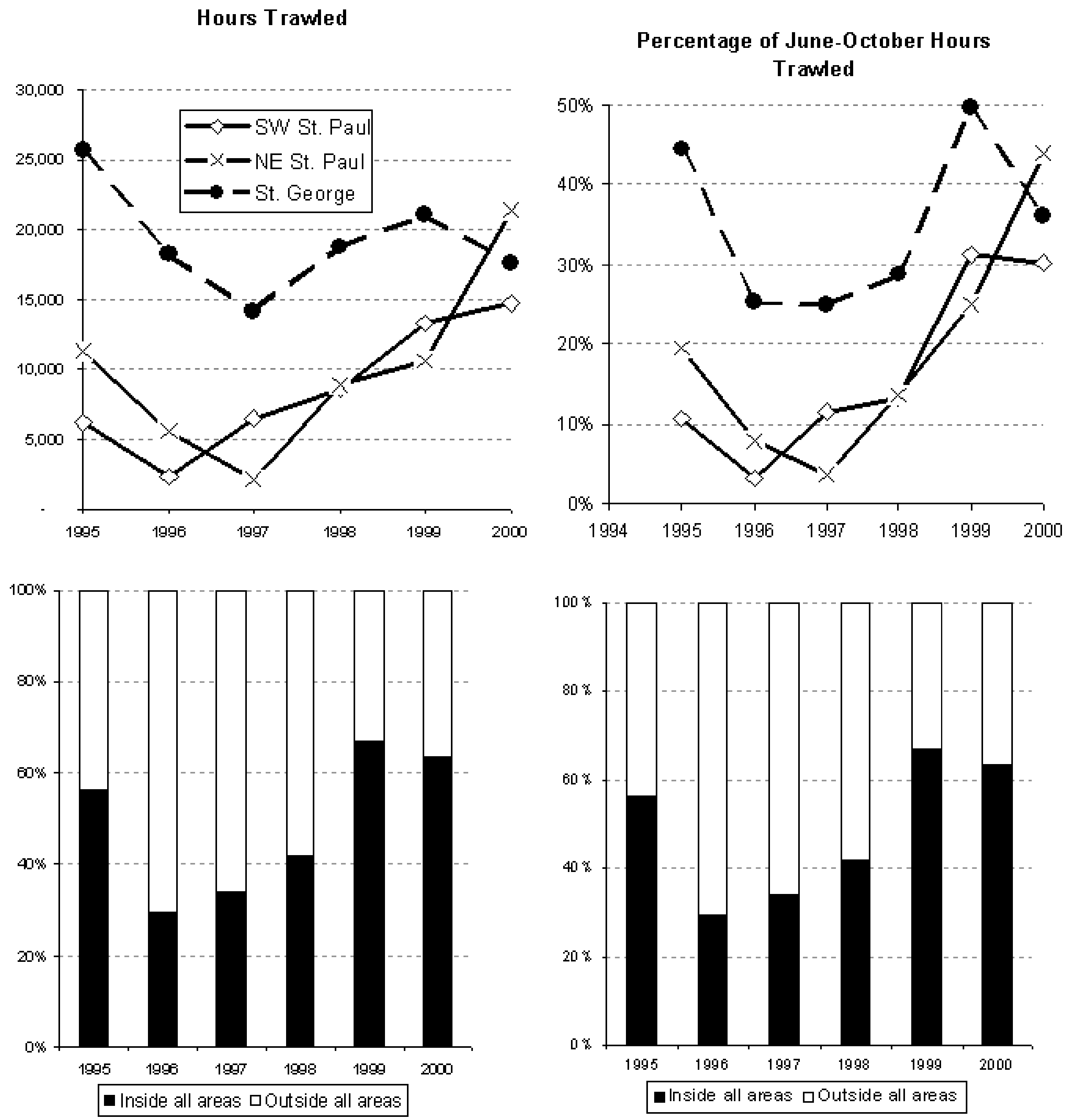
Under Alternatives 1-5, the effects of the groundfish fisheries on incidental take and harvest of prey species are expected to have insignificant population level effects on northern fur seals (Table 4.1-11), although the extent to which the FMP under any of the proposed Alternatives could change rates of fur seal entanglement in marine debris is unknown. Based on available information on northern fur seal foraging ecology during the breeding season, it is reasonable to conclude that the indirect effects of spatial and temporal fishery concentration under Alternatives 2-5 could plausibly have population level effects and are rated as conditionally significant negative under each alternative. The conclusion that the significance of these effects is conditionally negative for alternatives that open the fishery during June through August as well as September and October and close Steller sea lion foraging areas to fishing assumes that the displacement of the eastern Bering Sea pollock fishery northward into summer and fall foraging habitat of northern fur seals is likely to result in a competitive overlap with the fishery for fur seal prey, and spatial and temporal overlap with the fishery. Although increased vessel traffic could lead to a greater disturbance to fur seals and their prey the effects under each alternative are unknown.

Figure 4.1-1 Total catch of pollock during the summer and fall fishery in the eastern Bering Sea



Note: Upper panels show the total catch and percentage of catch for meta-home range area from southwest St. Paul Island, northeast St. Paul Island, and St. George Island. Lower panels show the total catch inside and outside all areas combined.

Figure 4.1-2 Hours trawled during the summer and fall Pollock fishery in the eastern Bering Sea



Note: Upper panels show the hours trawled and percentage of hours trawled for meta-home range areas from southwest St. Paul Island, northeast St. Paul Island, and St. George Island. Lower panels show the total catch inside and outside all areas combined.

Figure 4.1-3 Location of trawls (circles) during the summer-fall eastern Bering Sea pollock Fishery in 1997-2000.

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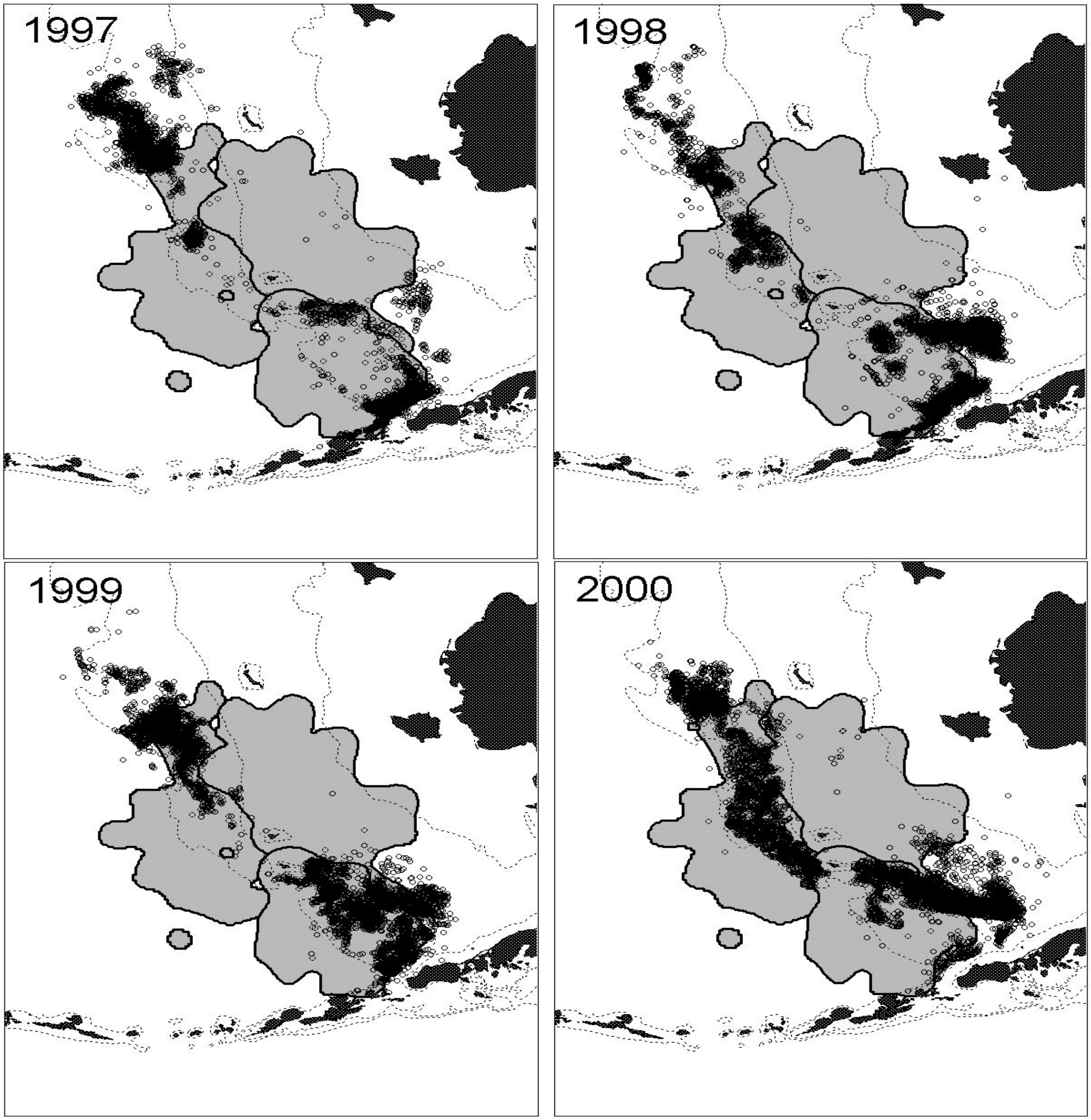

Source: The grey shaded areas show the meta-home range areas (see Figure 3.1.4-1) for lactating northern fur seals from St. Paul and St. George islands based on satellite telemetry data from 1995 and 1996 (Robson 2001)

4.1.5 Effects on Harbor Seals

Incidental takes of harbor seals by the groundfish fisheries operating the GOA and BSAI are uncommon. Harbor seal population estimates and trends are discussed in Section 3.1.5. Several harbor seal study sites have experienced dramatic population declines from the mid 1970s to the 1990s, however more recent population trends have shown a modest increase in numbers (Section 3.1.5). Direct and indirect interactions between harbor seals and groundfish fisheries occur due to overlap in the size and species of groundfish harvested in the fisheries that are also important harbor seal prey, and due to temporal and spatial overlap in harbor seal foraging and commercial fishing activities. Of the groundfish species targeted for harvest Atka mackerel, pollock, and flatfish in the BSAI and pollock and Pacific cod in the GOA are important prey species for harbor seals (Section 3.1.5). Harbor seals exhibit a preference for nearshore habitat. These animals do not range far and feed at shallow depths on a variety of prey, including pollock, Pacific cod and Atka mackerel. The foraging habits of harbor seals are discussed in Section 3.1.5.

The alternatives are discussed below in terms of four potential effects: 1) direct effects (incidental take or entanglement in marine debris), 2) fisheries harvest of prey species, 3) temporal and spatial concentration of the fishery, and 4) disturbance effects. The criteria used for determining the significance of effects on harbor seals is outlined in Table 4.1-1.

4.1.5.1 Effects on Alternative 1 on Harbor Seals

<u>Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)</u>

In both the GOA and BSAI, groundfish fisheries takes of harbor seals are at levels approaching zero and are insignificant factors in population trends. Reported cases of harbor seal entanglement in marine debris are less prevalent than for northern fur seals or Steller sea lions (Laist, 1987, 1997). Given their inshore distribution and the high frequency with which they are observed, the low incidence of entanglement is unlikely to be a result of few opportunities to document such events. Thus, the effect of direct take and entanglement in marine debris under Alternative 1 on harbor seal populations is rated as insignificant (Table 4.1-12).

<u>Direct Effects – Fisheries Harvest of Prey Species (Question 2)</u>

Pollock, Pacific cod and Atka mackerel are consumed by harbor seals in the GOA and BSAI area. The potential for competitive interaction from fisheries exists; however, competition would be largely dependent on the amount of fish removed and the temporal and spatial distribution of fishing effort. Daily removal rates as discussed in 4.1.1 and elsewhere are unlikely to effect near-shore feeding harbor seals and TAC levels are unchanged under Alternative 1. Thus, using the criteria for determining significance of effects on harbor seal populations in Table 4.1-1, Alternative 1 is given an insignificant ranking (Table 4.1-12).

<u>Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)</u>

Harbor seals exhibit a preference for nearshore habitat. These animals do not range far and feed at shallow depths on a variety of prey, including pollock, Pacific cod and Atka mackerel. Harbor seals would receive some protection from competitive interaction for prey resources under Alternative 1 to the extent that no transit/no trawl fishing areas exist within 3-20 nm of shore in areas of Steller sea lion haulout sites and rookeries that overlap with harbor seal locations. This is particularly so in the Aleutian Islands area where many of the no transit and trawl exclusion zones exist. A lesser degree of protection would be afforded in the Gulf of Alaska where fewer restricted areas are described in areas that overlap with nearshore harbor seal distribution. Few spatial restrictions exist around the Kodiak Archipelago, an area of significant harbor seal decline. A similar situation exists for Prince William Sound; however, the extent of federal groundfish fisheries in PWS is not great. Spatial and temporal concentration of the fisheries are unchanged under Alternative 1. Using the criteria for determining significance in Table 4.1-1, Alternative 1 is rated as conditionally significant negative (Table 4.1-12).

Indirect Effects – Disturbance Effects (Question 4)

Effects from disturbance are difficult to identify. Effects could result from acoustic impact in the environment, both above and in the water; direct displacement of animals from a feeding area; or displacement of prey, reducing the foraging efficiency of the harbor seals. Some local individual impact could occur for any one of the described effects. However, population level impacts are largely unknown for this type of effect. To the extent that fishing occurs in nearshore habitat and overlaps with harbor seal foraging areas, some unquantifiable amount of disturbance could occur. The effect would likely be negligible unless vessels were highly concentrated for a long period of time in a given area. Under Alternative 1 the level of disturbance is unchanged and is considered insignificant.

4.1.5.2 Effects of Alternative 2 on Harbor Seals

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Historical data indicate that the rate of incidental take of harbor seals in the Gulf of Alaska and Bering Sea is very low and does not pose a population level problem to these animals (i.e. less than 1 percent of the PBR in the BSAI and less than 0.2% in the GOA). Low TAC amounts under Alternative 2 (compared to TAC levels under Alternative 1) would most likely reduce the number of harbor seals taken by these fisheries. This effect is considered insignificant because the level of take is already at a level that does not pose a biological threat to harbor seal populations. The effect on harbor seal populations under Alternative 2 is considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-12).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

For Alternative 2, the deviation difference (described in section 4.1.1.1 and elsewhere) for pollock in the Bering Sea resulted in a +198 value (CS-), partly because this Alternative alone proposes seasonal fishing from November to December. Negative values (I to CS+) were calculated in the Aleutian Islands and Gulf of Alaska for pollock and cod. Atka mackerel removals were positive for the EBS/AI and western Aleutian Island (CS-) and insignificant for the central Aleutian. Overall, Alternative 2 had a +38 value (Table 4.1-3), suggesting more fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of +38, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar to all Alternatives.

Alternative 2 greatly reduces the TAC in the GOA and BSAI, which would result in a reduced competitive interaction occurring with harbor seals. In addition to the TAC reductions maximum daily catch limits are also imposed under Alternative 2 and are likely to provide beneficial effects to foraging harbor seals.

Thus, Alternative 2 provides greater protection from effects of harvesting harbor seal prey species than Alternative 1. Further, the reductions in TACs are substantial enough (i.e., more than 20%, for two key species) to rank them as conditionally significant positive according to the significance criteria established in Table 4.1-1. The combination of a positive average daily removal rate (deviation difference) resulting in an insignificant rating, and the TAC ranking of CS+, results in an overall ranking of Insignificant for this Alternative under question 2.

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

Temporal distribution also acts to increase the availability of prey. Four seasons would be established for pollock, Atka mackerel, and Pacific cod with 25% allocation by season. No rollover of TAC into the next season would be allowed. The temporal distribution at this level significantly redistributes the harvest over the whole year, preventing a greater amount of fish from being taken very early on in the year. For example, under Alternative 2, 25% of the TAC amount would be available between January 20 and March 15 compared to 50 % of a greater TAC being available over virtually the same time period (Jan. 20 to April 15). This measure should make more prey available in the winter months. Daily catch limits are also established under Alternative 2.

No fishing zones are established within 3 nm of all major haulout sites; no transit zones within 3 nm of 37 rookeries and no trawling for any groundfish species within SSL critical habitat. These restrictions result in fairly extensive protection areas throughout the GOA and BSAI range of harbor seals, including areas of special concern around significantly depressed populations (i.e. Kodiak). These protection areas also exist in nearshore habitat, important to harbor seal activity. Using the criteria for determining significance in Table 4.1-1 the effect on harbor seal populations under Alternative 2 is conditionally significant positive.

Indirect Effects – Disturbance Effects (Question 4)

Effects from disturbance are considered to be minimal under Alternative 2 because most of the nearshore habitat in which harbor seals undertake most of their activities has some degree of protection from fishing activity. Disturbance to harbor seals from fishing activities is generally considered to be minimal with no evidence to gauge population level effects. The disturbance effect on harbor seal populations under Alternative 2 is considered insignificant.

4.1.5.3 Effects of Alternative 3 on Harbor Seals

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The TAC levels under Alternative 3 will be somewhat reduced from Alternative 1 but higher than in Alternative 2. GOA pollock would have lower TACs than in Alternative 1. Given that the incidental take of harbor seals in these fisheries is already at a negligible level, further reductions in TAC would reduce the incidental bycatch. The effect of this reduction, however, would not represent a significant positive impact to harbor seal populations. The effects on harbor seal populations under Alternative 3 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-12).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

TAC levels for the prey species pollock, Pacific cod, and Atka mackerel (with the exception of pollock in the GOA) are unchanged under Alternative 3. Lower harvests of pollock in the GOA could be marginally better for harbor seals provided that the effort in areas significant to harbor seals also decreases. Using the criteria for determining significance in Table 4.1-1 the effect on harbor seal populations under Alternative 3 is rated insignificant (Table 4.1-12).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

Similarly to Alternative 1 and 2, Alternative 3 creates no transit zones within 3 nm of 37 rookeries and no fishing zones within 3 nm of haulout sites. Some of the closure areas overlap with areas of harbor seal haulout sites. As a result, harbor seals would also benefit from these closures. Alternative 3 also establishes substantial seasonal reductions in the amount of pollock and Pacific cod which may be harvested within Steller sea lion critical habitat. Alternative 3 establishes large open and closed areas from Prince William Sound to the end of the Aleutian chain. Increased protection for harbor seals would occur in the central and western Aleutian Islands areas. An open area in the eastern Aleutian Islands; however, would not be beneficial to harbor seals except in select nearshore sites where no fishing closures are in effect around rookeries that overlap with harbor seal distribution.

Additional open areas of concern for harbor seals are around the southern part of Kodiak Island (area 3 under this Alternative), area 5, and area 7. Numerous harbor seal haulout sites occur in these areas. The Kodiak area has experienced a significant decline in harbor seal populations over the last 20 years (~80%). While some increase in population has occurred in recent years, the population remains significantly depressed from historical levels. To the extent that fishing effort might be concentrated in this area, that effort could put additional pressure on foraging harbor seals. Similar concerns exist for the other open areas; although population trends are less well understood for these additional areas.

Temporal closures in critical habitat during the winter would mitigate some of this impact; however, to the extent that fishing effort occurs in relatively defined open areas in the summer when harbor seals are pupping and nursing their young, the animals' ability to find adequate forage could be reduced. Temporal distribution of fishing effort both inside and outside critical habitat could provide some degree of mitigation to the above-described effects.

Fishing under federal groundfish TACs in Prince William Sound are probably not extensive; however this is an open area for fishing that is of concern relative to harbor seals. The population trend for this area is declining and fishing pressure in this area could place an additional burden on these animals.

Catch limits inside critical habitat are likely to be beneficial to harbor seals by leaving more prey available for forage. Using the criteria for determining significance in Table 4.1-1 the effect on harbor seal populations under Alternative 3 is conditionally significant negative (Table 4.1-12).

Indirect Effects – Disturbance Effects (Question 4)

Disturbance effects would be minimized by the implementation of closure areas. To the degree that fishing becomes more concentrated in open areas, harbor seals in those areas could experience an increased disturbance effect. Disturbance to harbor seals by fishing effort, is, however, generally considered to be minimal with no evidence to gauge population level effects. The disturbance effects on harbor seal populations under Alternative 3 are considered insignificant.

4.1.5.4 Effects of Alternative 4 on Harbor Seals

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The TAC under Alternative 4 is virtually unchanged from the TAC level under Alternative 1 or 3; therefore this harvest removal level is, overall, not expected to change the incidental take amount of harbor seals or entanglements from marine debris. The existing incidental take is at a negligible level that is predicted not to affect the population(s) of harbor seals in the Bering Sea or Gulf of Alaska. The effects on harbor seal populations under Alternative 4 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-12).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

TAC levels for pollock, Pacific cod, and Atka mackerel would not change under Alternative 4. Some degree of competitive interaction by the pollock, Atka mackerel and Pacific cod fisheries would occur with harbor seals. Based solely on the amount of prey removed, the intensity interaction would be similar to that occurring under Alternative 1 and lesser than under Alternative 2. Daily removal rates as discussed in 4.1.1 and elsewhere are unlikely to effect near-shore feeding harbor seals and TAC levels are unchanged under Alternative 1. Thus, using the criteria for determining significance of effects on harbor seal populations in Table 4.1-1, Alternative 4 is given an insignificant ranking (Table 4.1-12).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

This alternative provides minimal global protections in nearshore habitat. No transit zones and no fishing zones occur within 3 nm of 37 rookeries and no fishing occurs within 0 - 20 nm of only 5 northern haulout sites. In this regard, the nearshore protection is more selective and less consistent than in the other alternatives.

To the extent that closed areas exist in nearshore areas that overlap with harbor seal haulout sites this alternative will afford some protection to harbor seals. For example, closures to Atka mackerel fishing in the Aleutian Islands and fishing to pollock fishing in the central and western Aleutian Islands exist in critical habitat area that overlaps, for the most part, with the distribution of harbor seals in this portion of their range. Fishing closures for Pacific cod in the BSAI in nearshore habitat would also provide some protection from competitive interaction as would the closures nearshore in the Gulf of Alaska. However, this alternative leaves open a large extent of the eastern and southern areas of Kodiak island to pollock and some Pacific cod fishing.

To the extent that the east and south sides of Kodiak Island remain open to fishing, some increased pressure could be present for harbor seals in these nearshore areas. As discussed above, the harbor seal population in the Kodiak Archipelago has suffered a significant decline in the last 20 years and has not recovered to historical levels.

Alternative 4 creates the option for some fixed gear, small vessel, nearshore fishing. Some of the nearshore waters in the Chignik area contain haulout sites of harbor seals that could be affected by the nearshore harvest of Pacific cod. Exemption areas around Dutch Harbor also contain numerous harbor seal haulout sites that could be affected negatively by fishing pressure on Pacific cod in the nearshore environment. Graduated zones of forage areas in the GOA for Pacific cod could provide some reduction in competitive interaction by minimizing the removal in nearshore areas.

The temporal dispersion of TAC harvest throughout the year so as to minimize large scale removals in any one area could provide some benefit to harbor seals. However, depending on the nature of the temporal dispersion as well as the nature of the fishing effort within the season the pressure may effectively not be reduced. For some fisheries, temporal dispersion occurs but a significant proportion of the TAC may be taken in a given season. For example, the Aleutian Island pollock TAC is fished in one season beginning January 20; the BS and AI cod trawl fisheries have 80% of the TAC apportioned from January 20 to June 10. In those instances when the TAC is heavily weighted to one season the true positive effect of temporal dispersion is not gained.

This is also true for the allocation of TAC by areas. For example, TAC in the AI Atka mackerel fishery is apportioned inside and outside critical habitat. The apportionment (70%/30%, respectively), however, allows more fishing to occur in nearshore habitat. While this represents some improvement over all of the TAC being harvested from within critical habitat, the removals are heavily weighted to areas inside critical habitat. This is the area in which harbor seals are more vulnerable to competitive pressure. Harbor seals would be particularly vulnerable at times when prey biomass is generally low and these times overlap with periods of high energetic demand, such as pupping and weaning, or during winter months. Using the criteria for determining significance in Table 4.1-1 the effect on harbor seal populations under Alternative 4 is conditionally significant negative (Table 4.1-10).

Indirect Effects – Disturbance Effects (Question 4)

Alternative 4 is not expected to cause disturbance effects any different from those already discussed under other alternatives. These effects are considered to be minimal. The disturbance effects on harbor seal populations under Alternative 4 are considered insignificant.

4.1.5.5 Effects of Alternative 5 on Harbor Seals

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

As previously discussed, the incidental take of harbor seals in the BSAI and GOA fisheries is minimal and not considered to be problematic for harbor seal populations. That take level is not expected to change under Alternative 5. The effects on harbor seal populations under Alternative 5 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-12).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

TAC levels under Alternative 5 are comparable to Alternatives 1, 3, and 4; although AI pollock TAC is significantly lower and more comparable to Alternative 2. As discussed above, some degree of competitive interaction is expected to occur; although the degree is unknown. Using the criteria for determining significance in Table 4.1-1 the effect on harbor seal populations under Alternative 5 is rated insignificant (Table 4.1-12).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

Rookery closures exist under Alternative 5; however, more global nearshore closures are absent from this alternative. Closures within 10 and 20 nm of 37 rookeries are considered to be beneficial to harbor seals where harbor seals haulout sites are found within the described areas. The area of greatest overlap in closure areas occurs in the Aleutian Islands. Harbor seals are much more widely dispersed in the GOA than the rookery closure areas. No pollock fishing zones are established within 10 or 20 nm of 75 haulout sites seasonally (January to June) or when Steller sea lions are present. The seasonal nature of the closures, however, is less protective than were they to remain in place year round. Spatial closures are minimal for the various fisheries under Alternative 5. To the extent that areas are left open for nearshore fishing for Pacific cod in the GOA, and seasonally for pollock, harbor seals are afforded less protection. Generally some large open areas exist, particularly in the Kodiak region, where fishing pressure concentrated in these areas could be problematic for the depressed harbor seal population.

Harvest limits (i.e. inside v. outside critical habitat) and seasonal allocations of pollock, cod and Atka mackerel would improve the availability of forage for harbor seals. The temporal distribution of TAC appears to be more evenly distributed than for some of the other alternatives. To the extent that large amounts of the TAC are not removed at a specific time of the year (and in particular during the early summer months when animals are pupping and weaning their young, as well as potentially in the winter) this provides greater opportunity for prey to be available to harbor seals. Using the criteria for determining significance in Table

4.1-1 the effect on harbor seal populations under Alternative 5 is conditionally significant negative (Table 4.1-12).

Indirect Effects – Disturbance Effects (Question 4)

Alternative 5 is not expected to cause disturbance effects any different that those already discussed under Alternative 1. These effects are considered to be minimal. The disturbance effects on harbor seal populations under Alternative 5 are considered insignificant.

4.1.5.6 Summary of Effects on Harbor Seals

The criteria used to determine the significance of effects on harbor seals is outlined in Table 4.1-1. Table 4.1-12 summarizes the effects of the alternatives on harbor seal populations.

Table 4.1-12 Summary of effects of Alternatives 1 through 5 on harbor seals.

Harbor Seals	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I	I	I	I	I
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	CS-	CS+	CS-	CS-	CS-
Disturbance	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Harbor seals would benefit most from management measures that displace pollock, cod and Atka mackerel fisheries farther offshore (i.e. greater than 20 nm) throughout much of the GOA and BSAI areas. Harbor seals are distributed almost continuously from Cape Suckling to the end of the Aleutian chain. The areas of greatest known concern for harbor seals are in Prince William Sound, the Kodiak area because populations in these areas have declined substantially in the last 20 years and remain depressed or continue to decline. Competitive interaction from fisheries that harvest pollock, cod and Atka mackerel in these areas could place significant additional burden on these populations.

Populations in the Bering Sea and the Aleutian Islands could be equally vulnerable to nearshore fishing pressure for these same fish species; however, the trend data is not available at this time to the same extent for the BSAI as for other areas of the harbor seal range in the GOA for similar areas of concern to be identified.

In addition to measures that move the fishing effort farther from shore, those measures that spread the effort out in time and space, as well as reduce the overall harvest amounts that can be removed are also likely to provide a greater benefit to harbor seal foraging success. The greatest degree of protection under the alternatives presented is likely to come from Alternative 2 which affords the greatest global protection by creating closure areas throughout the harbor seal range which moves the effort beyond 10 and 20 nm, as well as reducing TAC. This alternative also apportions the TAC relatively evenly throughout the year, without significantly weighting any given season.

While some of the other alternatives accomplish similar objectives they do so in part and in a more fractured manner. In addition, the complexity of some of the alternatives exceeds the state of knowledge of harbor seal dynamics. The result may be that greater protection is afforded in some cases, or, conversely that little or no additional protection is created by the additional management complexity. In some cases, however, we can infer that a greater impact to harbor seals is likely to occur from certain management measures (e.g., open fishing areas in the GOA around Kodiak island or harvest that is disproportionately weighted by season or area in times for which harbor seals may be more vulnerable i.e. winter months or pupping times).

4.1.6 Effects of the Alternatives on Other Pinnipeds

The "other pinnipeds" group includes the ice seals (spotted, bearded, ringed, and ribbon seals), Pacific walrus, and northern elephant seal. Ecological interactions between these species and commercial groundfish fisheries are limited by both spatial separation and differences between commercial harvest targets and the species food habits. The alternative management measures would be expected to have little or no effect on those species where contact with commercial fisheries remained limited.

In particular, the ice seal distributions tend toward seasonally or permanently ice-covered waters of the Beaufort, Chukchi, Bering, and Okhotsk Seas, which are generally north of most areas commercially fished for groundfish. The annual distribution of the seals depends on the extent of the sea ice, which can vary widely from year to year (Burns *et al.*, 1981a, b). The sea ice in the Bering Sea typically extends to the continental shelf break, but in heavy ice years, the ice edge can extend as far south as the eastern Aleutian Islands, while in light ice years, the ice edge can be as far north as St. Lawrence Island (Burns *et al.*, 1981b). Occasionally, individuals of each species can be found south of the ice edge in the Bering Sea, but infrequent contacts with fisheries would not precipitate population level effects.

Of the ice seals, the spotted seals occur closest to groundfish fishing areas, inhabiting the front zone of the pack ice (the transition zone between the southern fringe of ice and the heavier southward-drifting pack ice; Burns *et al.*, 1981a, Braham *et al.*, 1984) during the winter and spring. Spotted seals move to coastal waters of the Bering and Chukchi seas in summer and fall (Braham *et al.*, 1984; Lowry *et al.*, 1998; 2000), where their nearshore distribution would limit their contact with groundfish fisheries in much the same way it would for harbor seals. Spotted seals are less dependent than harbor seals on commercially targeted fish, as the pollock eaten by spotted seals in the Bering Sea are of smaller size than commercially targeted pollock (Frost and Lowry, 1986). Ribbon seals also inhabit the front zone of the pack ice (Burns, 1970; Braham *et al.*, 1984). Ribbon seals feed on pollock, but the size classes targeted are smaller than commercially targeted pollock (Frost and Lowry, 1980; Frost and Lowry, 1986). Little is known of the distribution and food habits of ribbon seals during the open water season (July-November).

Bearded seals, ringed seals and walrus are found in pack ice in the winter and spring, north of the ice front (Braham *et al.*, 1984). Bearded seals are found throughout the pack ice; they are benthic feeders, and although they have been known to eat pollock, it does not make up a large part of their diet (Lowry *et al.*, 1996), and thus there is little overlap with commercially targeted prey. Ringed seals are distributed in heavy pack ice (Braham *et al.*, 1984) or shorefast ice (McLaren 1958; Burns, 1970; Smith and Stirling, 1975; Smith, 1987), and thus would have no interaction with fisheries. In summer and fall, most bearded and ringed seals move north with the receding ice, away from Bering Sea commercial fishing grounds.

Effects on Pacific walrus would be small because of differences in their distribution (especially concerning areas used by large aggregations) and commercial fishing grounds. During the winter, walrus aggregate in heavy pack ice (Braham *et al.*, 1984), where fishing vessels would not be present. Although Pacific walrus occur in the shelf waters of the Bering Sea in the summer, most of the population congregates at the southern edge of the Chukchi Sea pack ice during this time (Allen 1880; Smirnov, 1929; Fay *et al.*, 1984). With the exception of adult males which remain in the Bering Sea during the summer, most habitat utilized by the population is associated with the availability of haulout sites on ice (Brooks, 1954; Burns, 1965; Fay, 1955; 1982; Fay *et al.*, 1984). Walrus remaining in the Bering Sea many use haulouts on Round Island, which is a State of Alaska preserve with a 12 nmi (22.2 km) no fishing zone established around it. Others may remain near haulouts on islands in the Bering Strait, the Punuk Islands, or the beaches at Cape Seniavin, all of which are adjacent to shallow waters not used by federally-managed groundfish fisheries.

Northern elephant seals occur in the GOA and Aleutian Islands during the spring and fall (Stewart and DeLong,1994; LeBoeuf *et al.*, 2000). Males migrate to foraging areas near the continental shelf break, where they spend 26-89 days feeding (LeBoeuf *et al.*, 2000; Stewart and DeLong, 1994); during this time they dive to a mean depth of 1024 ft (312 m). Seldom seen, they appear to have little or no contact with commercial fisheries. Based on their more southerly distribution and the positive trend in their population status, we assume that the effects of Alternative 1 or any of the other alternatives on them would be insignificant.

The alternatives are discussed below in terms of four potential effects: 1) direct effects (incidental take or entanglement in marine debris), 2) fisheries harvest of prey species, 3) temporal and spatial concentration of the fishery, and 4) disturbance effects. The criteria used for determining the significance of effects on other pinnipeds is outlined in Table 4.1-1.

4.1.6.1 Effects of Alternative 1 on Other Pinnipeds

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates in commercial fisheries for ice seals, walrus and northern elephant seals are very low. NMFS observers on board BSAI groundfish trawl, longline, and pot fishing vessels from 1990 to 1999 and logbook data from Bristol Bay salmon drift gillnet fishery from 1990 to 1993 reported nine spotted seals, ten bearded seals, two ringed seals, and three ribbon seals taken, resulting in estimated takes of 2.5, 0.6, 0 and 0.2 seals per year, respectively (Angliss *et al.*, 2001). These rates constitute levels approaching zero according to NMFS standards (Angliss *et al.*, 2001). Of the approximately 17 Pacific walrus that were caught each year in groundfish trawl fisheries in the eastern Bering Sea between 1990 and 1997, over 80% were already decomposed and not likely to have actually been killed as a result of fisheries interactions (Gorbics *et al.,* 1998). At a rate of 17 walrus per year, the take rate qualifies as an insignificant level, approaching zero by NMFS standards. NMFS observers on board BSAI and GOA groundfish trawl, longline, and pot fishing vessels from 1990 to 1999 reported six northern elephant seals were incidentally taken in the trawl and longline fishery. This take rate constitutes a level approaching zero by NMFS standards (Forney *et al.*, 2000). Entanglement in marine debris is likewise rare for these species and is considered to have insignificant effects.

Of the federally-managed fisheries in Alaska, only the eastern Bering Sea and Aleutian Islands pollock fishery would be likely to have an impact on ice seals and walrus, because of their northern distribution in the Bering Sea. Calculated estimates of incidental takes for all marine mammals (Table 4.1-2) indicate that in the eastern Bering Sea and Aleutian Islands pollock trawl fishery, 13 marine mammals other than Steller sea lions would be taken under Alternative 1. Given that only a few of these 13, if any, would be ice seals or walrus, this rate of incidental take constitutes a level approaching zero. Because of their distribution in Alaska in the Gulf of Alaska and south of the Aleutian Islands (Stewart and DeLong, 1994; LeBoeuf *et al.*, 2000), northern elephant seals would be likely to be affected only by the Gulf of Alaska and Aleutian Islands pollock and cod fisheries. Calculated estimates of incidental takes for all marine mammals (Table 4.1-2) indicate that in the Gulf of Alaska and Aleutian Islands fisheries, four marine mammals other than Steller sea lions would be taken under Alternative 1. This incidental take rate constitutes a level approaching zero for northern elephant seals.

Overall, direct effects on the other pinnipeds stemming from incidental take or entanglement in marine debris are considered insignificant. The effects on other pinniped populations under Alternative 1 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-13).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

With the exception of spotted seals and ribbon seals, the food habits of the ice seals do not overlap with commercial fisheries targets. Bearded seals consume primarily benthic prey including crabs and clams as well as shrimps and Arctic cod (Kosygin, 1966; 1971; Lowry *et al.*, 1980a; 1981a; 1981b). Ringed seals eat Arctic cod, saffron cod, smelt, herring, shrimps, amphipods and euphausiids (McLaren, 1958; Fedoseev, 1965; Johnson *et al.*, 1966; Lowry *et al.*, 1980b). Ribbon seals eat crustaceans, cephalopods, and fish, including pollock, Arctic cod, saffron cod, capelin, eelpout, sculpins, and flatfish (Arsen'ev, 1941; Shustov, 1965b; Frost and Lowry, 1980; Burns, 1981b; Lowry *et al.*, 1996). Spotted seals include pollock in their diet when feeding in the central and southeast Bering Sea (Bukhtiyarov *et al.*, 1984; Sobolevskii, 1996). Spotted seal diet is not very dependent on commercially harvested fish species, as the pollock they target are smaller (mean length 4.2 in [10.9 cm] in the Bering Sea and 6.2 in [15.9 cm] in the Okhotsk Sea; Frost and Lowry, 1986; Lowry *et al.*, 1996) than commercially targeted pollock (greater than 11.7 in [30 cm] in length; Wespestad and Dawson, 1992). Likewise, ribbon seals target smaller fish (1-year-old fish, mean length 4.4 in [11.2 cm]) than commercially targeted pollock (Frost and Lowry, 1980; Frost and Lowry, 1986). Thus, the effects on ice seals are insignificant under Alternative 1.

The diet of Pacific walrus is composed almost exclusively of benthic invertebrates (97%), particularly bivalve molluscs. Fish ingestion has been considered incidental to their normal feeding behavior (Fay and Stoker, 1982b). Groundfish removals would not have a meaningful effect on walrus populations. The diet of northern elephant seals in the GOA is unknown; however, the species is known to be a deep diver in Alaskan waters (Stewart and DeLong, 1994; LeBoeuf *et al.*, 2000). This behavior suggests that their foraging may be partitioned by depth from most groundfish fishing activities. The criteria used for determining the significance of an alternative's effect on pinniped populations set TAC removals for one or more key prey species at a level 5% to 20 % lower as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. While this criteria for lowered TACs has not been met, based on the lack of overlap between fisheries and the foraging behavior of ice seals, walrus and northern elephant seals (Section 4.1.6.1), the effects are considered insignificant under Alternative 1, with respect to the harvest of prey species (Table 4.1-13).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

In general, there is little spatial, temporal, or dietary overlap of ice seals, northern elephant seals, and walruses with groundfish fisheries. The criteria used for determining the significance of an alternative's effect on pinniped populations requires marginally less temporal and spatial concentration of the fisheries as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. While this criteria for reduced temporal and spatial concentration of the fisheries has not been met, given the lack of overlap with regard to species consumed versus fishery targets, there would be no spatial or temporal effects. The effects on other pinniped populations are considered insignificant under Alternative 1, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

Given the general lack of spatial, temporal, or dietary overlap with groundfish fisheries, disturbance effects caused by vessel traffic, noise, or fishing gear are likely to be small under all of the alternatives. Individual animals in the pinniped group venturing into fishing areas could temporarily modify their behavior; however, those cases would not constitute population level effects. Alternative 1 would not cause disturbance effects that would affect ice seals, walruses or northern elephant seals at a population level.. The disturbance effects on other pinniped populations would be similar under Alternative 1 and are considered insignificant.

4.1.6.2 Effects of Alternative 2 on Other Pinnipeds

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of other pinnipeds in the groundfish fisheries under Alternative 2 is expected to mirror rates under Alternative 1. In the Eastern Bering Sea and Aleutian Islands pollock trawl fishery, only 13 marine mammals other than Steller sea lions would be taken under Alternative 2; this is considered a level approaching zero for ice seals and walrus. For northern elephant seals, one marine mammal other than Steller sea lions would be taken under Alternative 2 in the Gulf of Alaska and Aleutian Islands pollock and cod fisheries; this is considered a level approaching zero.

The closure of the Steller sea lion Conservation Area in the Bering Sea to fishing vessels may result in a shift of fishing vessels northwards toward the Pribilof Islands and along the continental shelf break in the Bering Sea, as described in the Effects on Northern Fur Seals (Section 4.1.4). This northward redistribution of fishing vessels may result in closer proximity of fishing vessels to the ice edge during January-April, which may increase direct interaction with spotted and ribbon seals. The extent of such interaction is difficult to quantify, as it depends on the location of the ice edge as well as fishing locations: if the ice edge is farther north than usual, then the probability of increased direct interaction is small, but if the ice edge is at the continental shelf or farther south, then direct interaction may increase. However, because the extent of such interaction cannot be assessed, and is not likely to have population effects on ice seals. The effects on other pinniped populations under Alternative 2 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-13).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 2 reduces the catch of pollock and Pacific cod in Steller sea lion foraging habitat, and thus reduces the total amount of target and bycatch species from the amount caught in Alternative 1. Given that the TACs of several prey species are reduced by 5% to 20% in the BSAI and the lack of overlap between fisheries and the foraging behavior of ice seals, northern elephant seals and walrus the effects on other pinniped populations under Alternative 2 are considered insignificant.

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

In general, there is little spatial, temporal, or dietary overlap of ice seals, northern elephant seals, and walruses with groundfish fisheries. The criteria used for determining the significance of an alternative's effect on pinniped populations requires much less temporal and spatial concentration of the fisheries as a benchmark for reaching a conclusion of conditionally significant positive (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. Although this criteria is met under Alternative 2 given the lack of overlap with regard to species consumed versus fishery targets, there would be no spatial or temporal effects under Alternative 2 and so is rated insignificant.

Indirect Effects – Disturbance Effects (Question 4)

In general, there is little spatial or temporal overlap of ice seals, northern elephant seals, and walruses with groundfish fisheries; the only spatial and temporal overlap would depend on the extent of sea ice during the January-May time period, as described in Section 4.1.6.2. Because spotted seals and ribbon seals are distributed along the front zone of pack ice during January-April (Burns, 1970; 1981b; Lowry *et al.*, 2000), seals may be disturbed by fishing vessels that venture close to the leading edge of the ice. Spotted seals are more likely to be disturbed than ribbon seals, as they are distributed in the southern part of the ice front (i.e., closer to the ice edge; Burns *et al.*, 1981b; Braham *et al.*, 1984) and they are easily disturbed into the water when they are hauled out on ice (Braham *et al.*, 1984; Lowry, 1984). The effect of this disturbance would be greatest during March-May, when spotted seals have pups on the ice (Burns *et al.*, 1981b; Braham *et al.*, 1984; Lowry, 1984), and during the molting season from May-June, when larger groups (concentrations of tens to hundreds) of spotted seals are hauled out on ice remnants (Lowry, 1984). One concern during the pupping season is that disturbance of nursing mothers, if repetitive, could result in abandonment of pups or hauling areas (Lowry, 1984). As noted in Section 4.1.6.2, if the closure of Steller sea lion Conservation Area results in a northern shift of fishing activity closer to the ice edge, there may be an increase in disturbance effects for spotted seals; however, this is difficult to quantify and may not result in a substantial change in disturbance effects.

Given the general lack of spatial, temporal, or dietary overlap with groundfish fisheries, disturbance effects caused by vessel traffic, noise, or fishing gear are likely to be small under Alternative 2. Individual animals in the pinniped group venturing into fishing areas could temporarily modify their behavior; however, those cases would not constitute population level effects. Alternative 2 would not cause disturbance effects that would affect ice seals, walruses or northern elephant seals at a population level. The disturbance effects on other pinniped populations under Alternative 2 are considered insignificant.

4.1.6.3 Effects of Alternative 3 on Other Pinnipeds

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of other pinnipeds in the groundfish fisheries under Alternative 3 is expected to mirror rates under Alternative 1. In the Eastern Bering Sea and Aleutian Islands pollock trawl fishery, only 13 marine mammals other than Steller sea lions would be taken under Alternative 3; this is considered a level approaching zero for ice seals and walrus. For northern elephant seals, three marine mammals other than Steller sea lions would be taken under Alternative 3 in the Gulf of Alaska and Aleutian Islands pollock and cod fisheries; this is considered a level approaching zero.

As with Alternative 2, closure of RPA Areas (Area 8 and 9) under Alternative 3 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands and continental shelf, and may result in closer proximity of fishing vessels to the ice edge during January-April, which may in turn increase direct interaction with spotted and ribbon seals. However, because the extent of such interaction cannot be assessed because of variability in the extent of the sea ice edge (Section 4.1.6.2), and is not likely to have population effects on ice seals. The effects on other pinniped populations under Alternative 3 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-13).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

The criteria used for determining the significance of an alternative's effect on pinniped populations set TAC removals for one or more key prey species at a level 5% to 20 % lower as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. While this criteria for lowered TACs has not been met, based on the lack of overlap between fisheries and the foraging behavior of ice seals, walrus and northern elephant seals (Section 4.1.6.1), the effects are considered insignificant under Alternative 3, with respect to the harvest of prey species (Table 4.1-13).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

In general, there is little spatial, temporal, or dietary overlap of ice seals, northern elephant seals, and walruses with groundfish fisheries. Based on the reduction of the temporal and spatial concentration of the fisheries under Alternative 3 and given the lack of overlap with regard to species consumed versus fishery targets, the effects on other pinniped populations are considered insignificant under Alternative 3, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

As with Alternative 2, closure of RPA Areas (Area 8 and 9) under Alternative 3 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands and continental shelf, and may result in closer proximity of fishing vessels to the ice edge during January-April, which may in turn increase disturbance effects on spotted seals (Section 4.1.6.2). However, the extent of such disturbance cannot be assessed because of variability in the extent of the sea ice edge (Section 4.1.6.2), and is not likely to have population effects on ice seals. Given the general lack of spatial, temporal, or dietary overlap with groundfish fisheries, disturbance effects caused by vessel traffic, noise, or fishing gear are likely to be small for ice seals, walruses, or northern elephant seals under Alternative 3. The disturbance effects on other pinniped populations would be similar under Alternative 3 and are considered insignificant.

4.1.6.4 Effects of Alternative 4 on Other Pinnipeds

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of other pinnipeds in the groundfish fisheries under Alternative 4 is expected to mirror rates under Alternative 1. In the Eastern Bering Sea and Aleutian Islands pollock trawl fishery, only 13 marine mammals other than Steller sea lions would be taken under Alternative 4; this is considered a level approaching zero for ice seals and walrus. For northern elephant seals, four marine mammals other than Steller sea lions would be taken under Alternative 4 in the Gulf of Alaska and Aleutian Islands pollock and cod fisheries; this is considered a level approaching zero.

Under Alternative 4, only the Steller sea lion Conservation Area will be closed to trawling for pollock, and catcher-processors will be excluded from the CVOA from June 10-December 31. Because the winter season is not affected by the exclusion of catcher-processors from the CVOA, the northward shift of fishing vessels (Section 4.1.6.2) may not be as marked as in Alternative 2 or 3, and potential for interaction with ice seals may not increase. However, because the extent of such interactions cannot be assessed because of variability in the extent of the sea ice edge (Section 4.1.6.2), and is not likely to have population effects on ice seals, the effects on other pinniped populations under Alternative 4 is considered insignificant, with respect to incidental take and entanglement in marine debris (Table 4.1-13).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

The criteria used for determining the significance of an alternative's effect on pinniped populations set TAC removals for one or more key prey species at a level 5% to 20 % lower as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. While this criteria for lowered TACs has not been met, based on the lack of overlap between fisheries and the foraging behavior of ice seals, walrus and northern elephant seals (Section 4.1.6.1), the effects are considered insignificant under Alternative 4, with respect to the harvest of prey species (Table 4.1-13).

<u>Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)</u>

The criteria used for determining the significance of an alternative's effect on pinniped populations requires marginally less temporal and spatial concentration of the fisheries as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. While this criteria for reduced temporal and spatial concentration of the fisheries has not been met, given the lack of overlap with regard to species consumed versus fishery targets, there would be no spatial or temporal effects. The effects on other pinniped populations are considered insignificant under Alternative 4, with respect to the temporal and spatial concentration of the fisheries.

<u>Indirect Effects – Disturbance Effects (Question 4)</u>

Under Alternative 4, only the Steller sea lion Conservation Area will be closed to trawling for pollock, and catcher-processors will be excluded from the CVOA from June 10-December 31. Because the winter season is not affected by the exclusion of catcher-processors from the CVOA, the northward shift of fishing vessels (Section 4.1.6.2) may not be as marked as in Alternative 2 or 3, and potential for increased disturbance of seals may not increase. The extent of such disturbance cannot be assessed because of variability in the extent of the sea ice edge (Section 4.1.6.2), and is not likely to have population effects on ice seals. Given the general lack of spatial, temporal, or dietary overlap with groundfish fisheries, disturbance effects caused by vessel traffic, noise, or fishing gear are likely to be small for ice seals, walruses, or northern elephant seals under Alternative 4. The disturbance effects on other pinniped populations would be similar under Alternative 4 and are considered insignificant.

4.1.6.5 Effects of Alternative 5 on Other Pinnipeds

<u>Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)</u>

The incidental take of other pinnipeds in the groundfish fisheries under Alternative 5 is expected to mirror rates under Alternative 1. In the Eastern Bering Sea and Aleutian Islands pollock trawl fishery, only 13 marine mammals other than Steller sea lions would be taken under Alternative 5; this is considered a level approaching zero for ice seals and walrus. For northern elephant seals, four marine mammals other than Steller sea lions would be taken under Alternative 5 in the Gulf of Alaska and Aleutian Islands pollock and cod fisheries; this is considered a level approaching zero.

Alternative 5 is derived from the suite of RPA measures that were in place for the 2000 pollock and Atka mackerel fisheries. Alternative 5 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands, due to the closure of the Steller sea lion Conservation Area. As such, fishing vessels may be operating closer to the ice edge during January-April, which may in turn increase direct interaction with spotted and ribbon seals. However, because the extent of such interaction cannot be assessed because of variability in the extent of the sea ice edge (Section 4.1.6.2), and is not likely to have population effects on ice seals. Overall, direct effects on the other pinnipeds stemming from incidental take or entanglement in marine debris are considered insignificant. The effects on other pinniped populations under Alternative 5 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-13).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

The criteria used for determining the significance of an alternative's effect on pinniped populations set TAC removals for one or more key prey species at a level 5% to 20 % lower as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. While this criteria for lowered TACs has not been met, based on the lack of overlap between fisheries and the foraging behavior of ice seals, walrus and northern elephant seals (Section 4.1.6.1), the effects are considered insignificant under Alternative 5, with respect to the harvest of prey species (Table 4.1-13).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

The criteria used for determining the significance of an alternative's effect on pinniped populations requires marginally less temporal and spatial concentration of the fisheries as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. While this criteria for reduced temporal and spatial concentration of the fisheries has not been met, given the lack of overlap with regard to species consumed versus fishery targets, there would be no spatial or temporal effects. The effects on other pinniped populations are considered insignificant under Alternative 5, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

As with Alternative 2, closure of the Steller sea lion Conservation Area under Alternative 5 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands and continental shelf, and may result in closer proximity of fishing vessels to the ice edge during January-April, which may in turn increase disturbance effects on spotted seals (Section 4.1.6.2). However, the extent of such disturbance cannot be assessed because of variability in the extent of the sea ice edge (Section 4.1.6.2), and is not likely to have population effects on ice seals. Given the general lack of spatial, temporal, or dietary overlap with groundfish fisheries, disturbance effects caused by vessel traffic, noise, or fishing gear are likely to be small for ice seals, walruses, or northern elephant seals under Alternative 5. The disturbance effects on other pinniped populations would be similar under Alternative 5 and are considered insignificant.

4.1.6.6 Summary of Effects on Other Pinnipeds

The criteria used to determine the significance of effects on other pinnipeds is outlined in Table 4.1-1. In cases where the criteria in Table 4.1-1 for a rating of conditionally significant positive or negative were met but not used for questions 2 and 3, these cases are discussed in the analyses of the individual alternatives above. Table 4.1-13 summarizes the effects of the alternatives on other pinniped populations. In all cases, the direct and indirect effects of all alternatives are expected to have insignificant effects on other pinnipeds (Table 4.1-1) because there is little spatial, temporal or dietary overlap of ice seals, northern elephant seals and walruses with groundfish fisheries.

Table 4.1-13 Summary of effects of Alternatives 1 through 5 on other pinnipeds.

Other Pinnipeds	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I	I	I	I	I
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	I	I	I	I	I
Disturbance	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.1.7 Effects on Sea Otters

The USFWS estimates the total sea otter population size in Alaska at 70,500 (USFWS, unpublished)[17]. Currently, only the sea otter stock in California is listed as threatened under the ESA; the population in Alaska is neither listed as threatened or endangered under the ESA nor as depleted under the Marine Mammal Protection Agency. However, the Alaskan population has been experiencing severe declines in the central portion of its range in recent years (Estes *et al.,* 1998). As a result, the USFWS is conducting a formal review to determine whether or not the Alaskan population should be considered for listing pursuant to the ESA. Estes *et al.* (1998) suggested that increased predation by killer whales is the likely cause of these declines. Further, the authors speculate that the increased predation may have resulted from declines in the populations of other killer whale prey, namely Steller sea lions and harbor seals. If this hypothesis is correct, then any impact the groundfish fisheries may have on Steller sea lion recovery could also be considered a factor in the sea otter declines, in so far as they may have contributed to a shift in predator-prey relationships. Having said that, no data currently exist to test the validity of this hypothesis and for the purposes of this analysis, only the proximal effects of fisheries on sea otters can be evaluated.

The alternatives are discussed below in terms of four potential effects: 1) direct effects (incidental take or entanglement in marine debris), 2) fisheries harvest of prey species, 3) temporal and spatial concentration of the fishery, and 4) disturbance effects. The criteria used for determining the significance of effects on sea otters is outlined in Table 4.1-1.

4.1.7.1 Effects of Alternative 1 on Sea Otters

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

Sea otter interactions with fishing gear, either passive or active are infrequent. Laist (1997) reported that sea otter entanglement in marine debris is rare. Likewise, incidental takes in fishing gear occur at a rate too low to cause population level effects. While the PBRs for the three sea otter stocks in Alaska were 871 (southeast), 2,095 (southcentral) and 5,699 (southwest), mortalities incidental to commercial fishing were 0, less than 1, and less than 2 per year, respectively.

A recent summary by population stock related to groundfish interactions was provided by the USFWS. For the southeast stock, no mortality was reported from 1990-1993. Self-reported fishers were incomplete for

[17] R. Meehan, "Personal Communication," 1011 E. Tudor Road, Anchorage, AK 99503.

1994 and not available for succeeding years. In south-central Alaska, Self-reported fishers show one kill and four injuries in 1990 due to gear interactions and three injuries due to deterrence in Prince William Sound, Copper River, and Bering River drift-gillnet fishery. No mortalities were reported from 1991 to 1993 and 1996. There are no current estimates for 1997 to the present. In southwest Alaska, the NOAA observer program reported eight kills in the Aleutian Islands black cod pot fishery in 1992. No other sea otter kills were reported by NOAA observers in the region from 1990 to 1996. One kill from gear interactions was self-reported in the Alaska-Kodiak salmon gillnet fishery in 1991. Otherwise, no kills were reported from 1990 to 1993 and 1996. In the 2000 "List of Fisheries" sea otters were added to the Bering Sea and Aleutian Islands groundfish trawl as a "species recorded as taken in this fishery." The USFWS is currently pursuing information regarding the extent of that possible interaction.

The total fishery mortality and serious injury for the Alaska sea otter is considered to be insignificant (i.e., less than 10% of the calculated PBR). The effects on sea otters under Alternative 1are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-14).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

The effects of the alternatives on sea otters are limited by differences between their prey and the fisheries harvest targets. Sea otters consume a wide variety of prey species, including annelid worms, crabs, shrimp, mollusks (e.g., chitons, limpets, snails, clams, mussels, and octopus), sea urchins, and tunicates. Occasionally, groundfish (e.g., sablefish, rock greenling, and Atka mackerel) may also be consumed but invertebrates are considered the predominant elements of their diet. Given the minor importance of groundfish in their diet, fisheries removals are not expected to have significant effects under any of the proposed alternatives. For the reasons discussed in Section 4.1.6.1, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 1, with respect to the harvest of prey species.

Indirect Effects – Spatial and Temporal Concentrations of Fishery (Question 3)

There is little basis for suggesting competition for forage between sea otters and commercial fisheries occurs, despite the species broad geographical distribution in the Gulf of Alaska and the Aleutian Islands. Sea otters inhabit waters of the open coast, as well as bays and the inside passages of southeastern Alaska. Because their primary prey items are found on the bottom in the littoral zone, to depths of 164 feet (50 m), the majority of otters feed within 0.6 miles (1 km) of the shore (Kenyon 1981). In areas, where shallow waters extend far offshore (e.g., Unimak Island), sea otters have been reported as far as 10 miles (16 km) offshore. They are often seen resting and diving for food in and near kelp beds (Kenyon 1969). Because of this habitat preference for shallow areas, they do not overlap spatially with groundfish fisheries. For the reasons discussed in Section 4.1.6.1, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 1, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

There are several sources of potential Level B harassment of sea otters in the coastal waters of Alaska. These include: small boat traffic (boat strikes), float plane landings and take offs, and mariculture sites. Other potential sources of disturbance include changes in forage behavior to include feeding on fish offal and foraging in harbor areas which have heavy contamination. USFWS has no data at present to suggest that any one of these factors alone are impacting sea otters at the population level.

As noted for many of the other marine mammals, the effects of disturbance caused by vessel traffic, fishing operations, or sound production on sea otters in the GOA and BSAI are expected to be not significant. Sea otters exhibit considerable tolerance for vessel traffic and in some cases are attracted to small boats passing by (Richardson *et al.,* 1995). Sea otters may be more tolerant of underwater sound relative to other species, owing to the greater amount of time they spend at the surface. Overall, given these attributes, as well as the spatial partitioning of sea otters and groundfish fishing operations, disturbance effects are considered to be minimal under all of the alternatives. The disturbance effects on sea otters would be similar under Alternative 1 and are considered insignificant.

4.1.7.2 Effects of Alternative 2 on Sea Otters

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

With regard to incidental take, Alternative 2 is not likely to result in significant changes in the rate of direct mortality relevant at the population level. Under Alternative 2, TACs for pollock, Pacific cod, and Atka mackerel are reduced; thus, proportional reductions in incidental take could be expected. However, the apportionment of the TAC reductions did not result in the reduction of the expected incidental catch of Steller sea lions With respect to entanglement in marine debris, Alternative 2 does not alter the effects described under Alternative 1. That is, the effect is insignificant. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with. The effects on sea otters under Alternative 2 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-14).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 2 would establish four equal seasons throughout the year for pollock and would prohibit trawling in critical habitat including the SCA and waters around Kodiak. However, given the minor importance of groundfish in their diet, fisheries removals are not expected to have significant effects under any of the proposed alternatives. For the reasons discussed in Section 4.1.6.2, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 2, with respect to the harvest of prey species.

Indirect Effects – Spatial and Temporal Concentrations of Fishery (Question 3)

For the same reasons listed under Alternative 1, and for the reasons discussed in Section 4.1.6.2, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 2, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on sea otters cannot be demonstrated with existing data. The scale of change in fishing activity imposed under Alternative 2 results in marginally less disturbance which may be beneficial for sea otters, however given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established (Table 4.1-1), measures which would result in even less disturbance than that which is insignificant are also rated as insignificant.

4.1.7.3 Effects of Alternative 3 on Sea Otters

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Alternative 3 does not alter the effects described under Alternative 1. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with. The effects on sea otters under Alternative 3 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-14).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 3 would establish four equal seasons throughout the year for pollock and would prohibit trawling in critical habitat including the SCA and waters around Kodiak. However, given the minor importance of groundfish in their diet, fisheries removals are not expected to have significant effects under any of the proposed alternatives. For the reasons discussed in Section 4.1.6.3, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 3, with respect to the harvest of prey species.

Indirect Effects – Spatial and Temporal Concentrations of Fishery (Question 3)

Alternative 3 would prohibit trawling from November 1 through January 20, retain winter (A/B) and fall (C/D) seasons and establish four seasons within the open Steller sea lion critical habitat zones. The SCA would be closed to fishing except for area 7 and waters around Kodiak would be closed in area 2 , roughly the northern half, but not in area 3, roughly the southern half. For the same reasons listed under Alternative 1, and for the reasons discussed in Section 4.1.6.3, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 3, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

The same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on sea otters cannot be demonstrated with existing data. However, Alternative 3 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 3 nm of haulout sites. It also contains a minor reduction in TACs of less than 1% for pollock, Pacific cod, and Atka mackerel resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Thus, the scale of change in fishing activity imposed under Alternative 3 results in marginally less disturbance, which may be beneficial for sea otters, however given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established (Table 4.1-1), measures which would result in even less disturbance than that which is insignificant are also rated as insignificant.

4.1.7.4 Effects of Alternative 4 on Sea Otters

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Alternative 4 does not alter the effects described under Alternative 1. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with. The effects on sea otters under Alternative 4 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-14).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 4 would not result in a change in the TAC levels for targeted fisheries. However, given the minor importance of groundfish in their diet, fisheries removals are not expected to have significant effects under any of the proposed alternatives. For the reasons discussed in Section 4.1.6.4, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 4, with respect to the harvest of prey species.

Indirect Effects – Spatial and Temporal Concentrations of Fishery (Question 3)

Alternative 4 establishes an A season and B season for pollock in the Bering Sea, from January 20 to June 10, and June 11 to October 31, respectively. Four seasons throughout the year would be established for pollock in the Gulf of Alaska. Area 9 of the SCA would be closed to trawling, but areas 7 and 8 would be open except for a portion restricted in the pollock A season and no CVOA trawling from June 10 to December 31. Areas around Kodiak Steller sea lion haulouts and rookeries would be closed. These changes are considered insignificant to sea otters. For the same reasons listed under Alternative 1, and for the reasons discussed in Section 4.1.6.4, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 4, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on sea otters cannot be demonstrated with existing data. However, Alternative 4 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 3 nm of haulout sites. It also contains a variety of schemes to reduce fisheries impacts on Steller sea lions across the GOA and Aleutian Islands. The scale of change in fishing activity imposed under Alternative 4 results in marginally less disturbance, which may be beneficial for sea otters, however given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established (Table 4.1-1), measures which would result in even less disturbance than that which is insignificant are also rated as insignificant.

4.1.7.5 Effects of Alternative 5 on Sea Otters

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Alternative 5 does not alter the effects described under Alternative 1. That is, there is no significant effect. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with. The effects on sea otters under Alternative 5 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-14).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 5 would not result in a change in the TAC levels for targeted fisheries. However, given the minor importance of groundfish in their diet, fisheries removals are not expected to have significant effects under any of the proposed alternatives. For the reasons discussed in Section 4.1.6.5, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 5 with respect to the harvest of prey species.

Indirect Effects – Spatial and Temporal Concentrations of Fishery (Question 3)

Alternative 5 would establish four seasons in the Bering Sea pollock fishery and four seasons in the Gulf of Alaska pollock fishery. Portions of SCA areas 7 and 8 would be closed to catcher-processor pollock trawling from June 10 to December 31. These measures are not considered significant to sea otters. For the same reasons listed under Alternative 1, and for the reasons discussed in Section 4.1.6.5, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 5, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on sea otters cannot be demonstrated with existing data. However, Alternative 5 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 10 or 20 nm of 37 rookeries to trawling year-round. It also contains a reduction in TACs of 92% for pollock in the Aleutian Islands (bycatch only), which is an overall reduction of less than 1% for the groundfish TAC for pollock, Pacific cod, and Atka mackerel resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Thus, the scale of change in fishing activity imposed under Alternative 5 results in marginally less disturbance, which may be beneficial for sea otters, however given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established (Table 4.1-1), measures which would result in even less disturbance than that which is insignificant are also rated as insignificant.

4.1.7.6 Summary of Effects on Sea Otters

The criteria used to determine the significance of effects on sea otters is outlined in Table 4.1-1. In cases where the criteria in Table 4.1-1 for a rating of conditionally significant positive or negative were met but not used for questions 2 and 3, these cases are discussed in the analyses of the individual alternatives above. Table 4.1-14 summarizes the effects of the alternatives on sea otters. In all cases, the direct and indirect effects of all alternatives are expected to have insignificant effects on sea otters (Table 4.1-1) because there is little spatial, temporal or dietary overlap of sea otters with groundfish fisheries.

Table 4.1-14 Summary of effects of Alternatives 1 through 5 on sea otters.

Sea Otters	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I	I	I	I	I
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	I	I	I	I	I
Disturbance	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

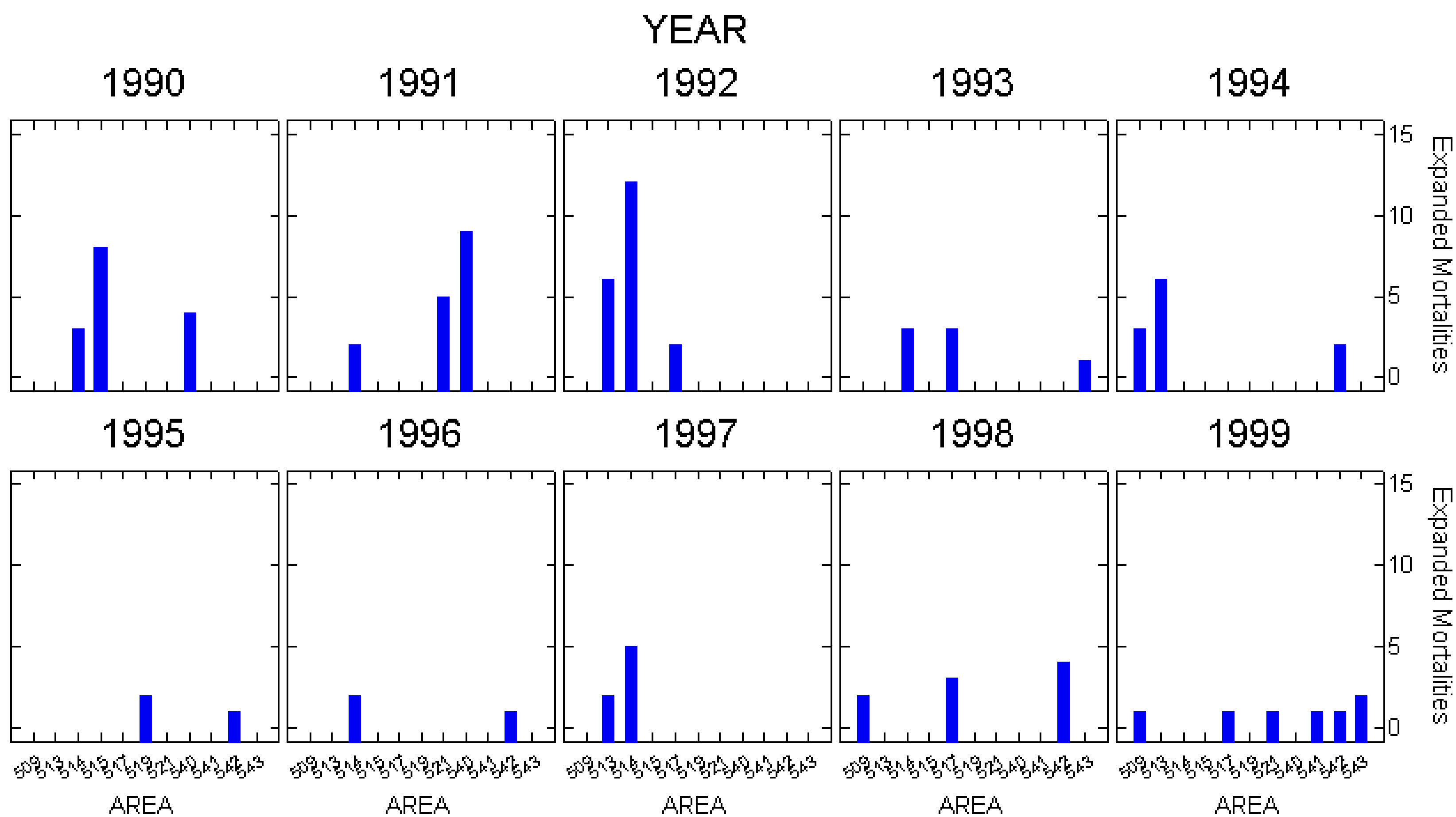

Figure 4.1-4 Distribution of Bering Sea groundfish trawl fishery incidental catch of Steller lea lions by fishery area and year, 1990-1999. Data: NMFS

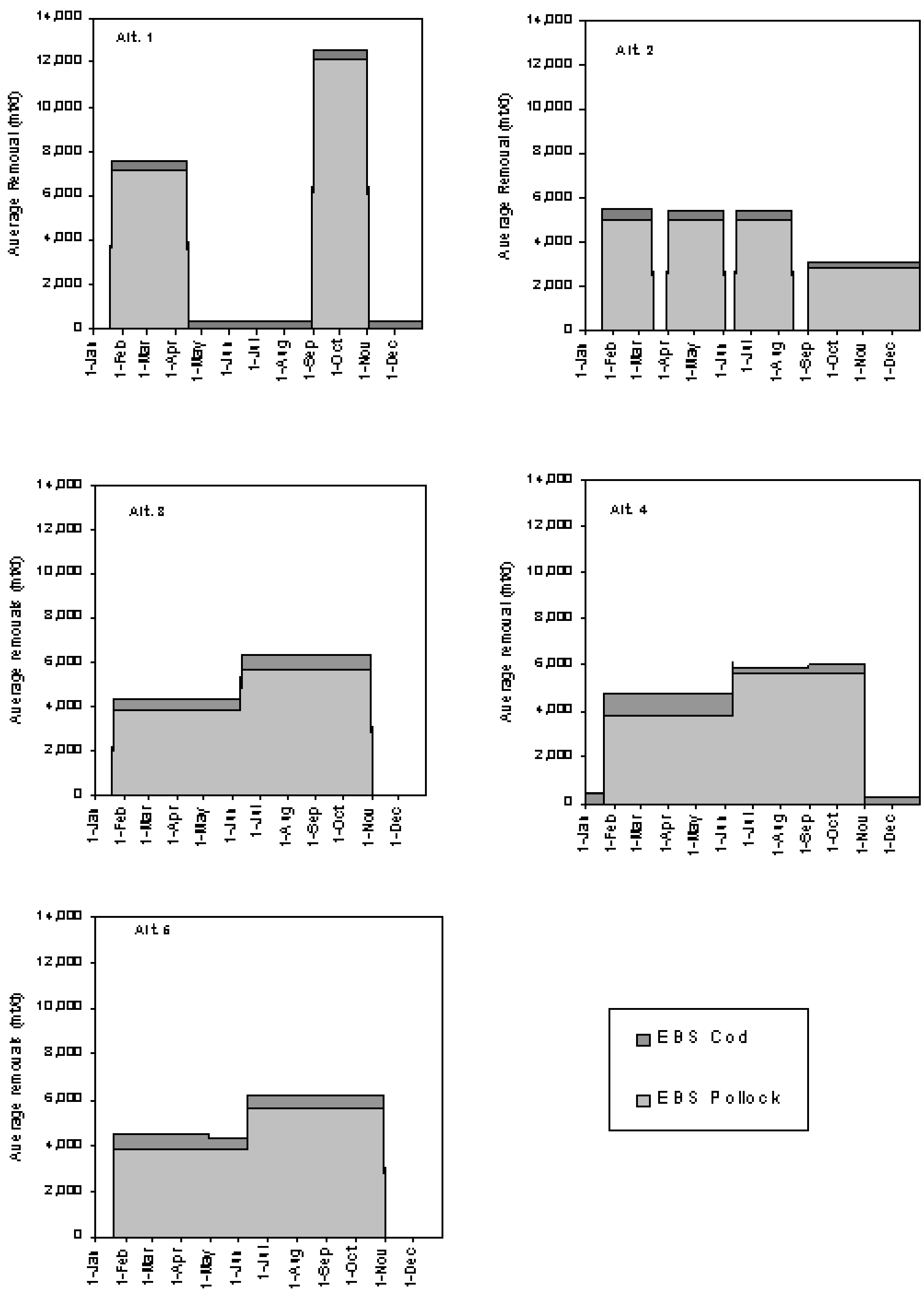

Figure 4.1-5 **Projected average daily removal rates of Eastern Bering Sea pollock and Pacific cod for each Alternative.**

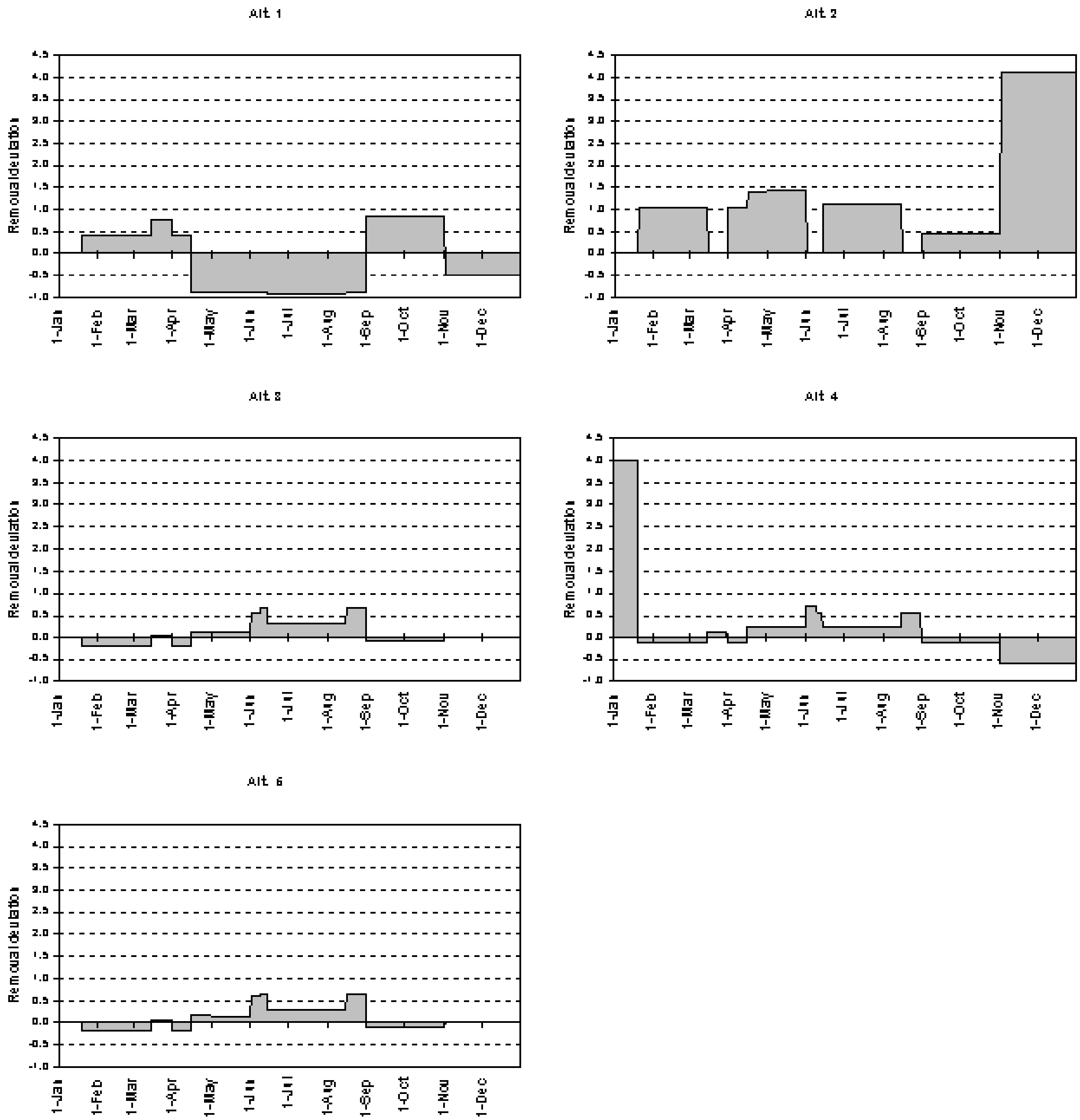

Figure 4.1-6 Deviations of relative mean daily removal rates for Eastern Bering Sea pollock and Pacific cod fisheries based on projected seasonal allocation of total allowable catch for each Alternative.

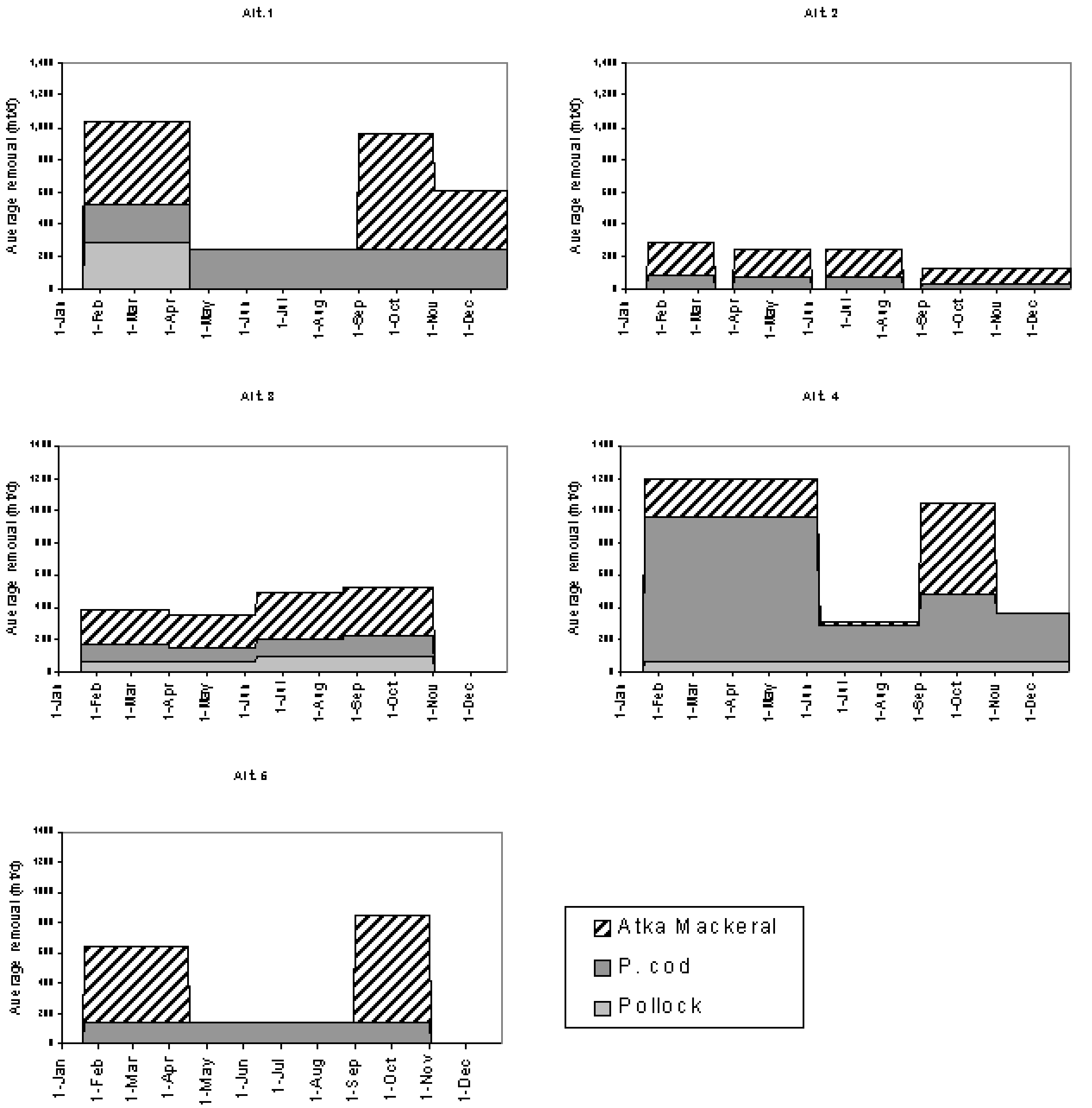

Figure 4.1-7 **Projected average daily removal rates of Aleutian Island pollock, Pacific cod and Atka mackerel for each Alternative.**

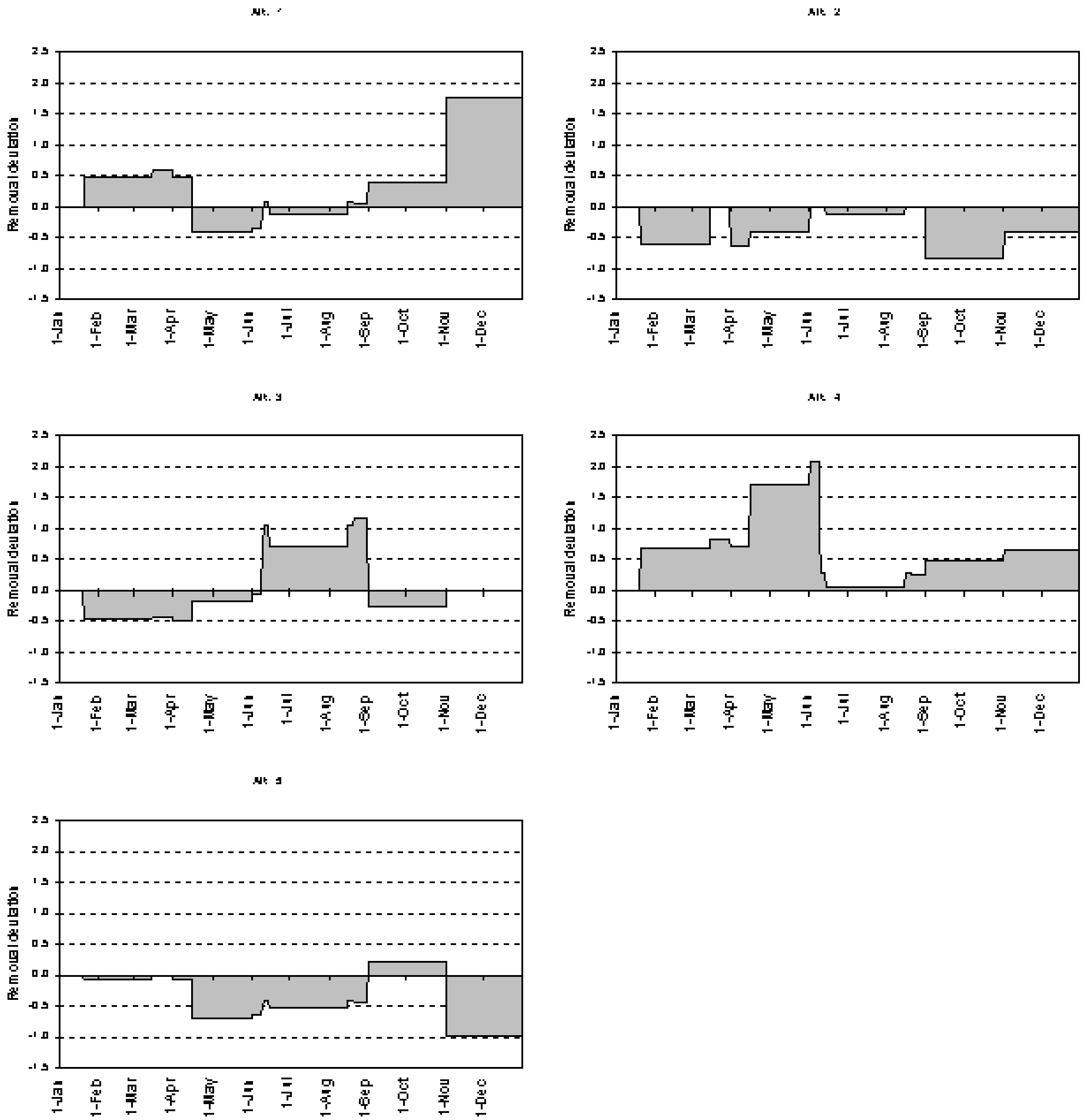

Figure 4.1-8 Deviations of relative mean daily removal rates for Aleutian Island pollock, Pacific cod and Atka mackerel fisheries based on projected seasonal allocation of total allowable catch for each Alternative.

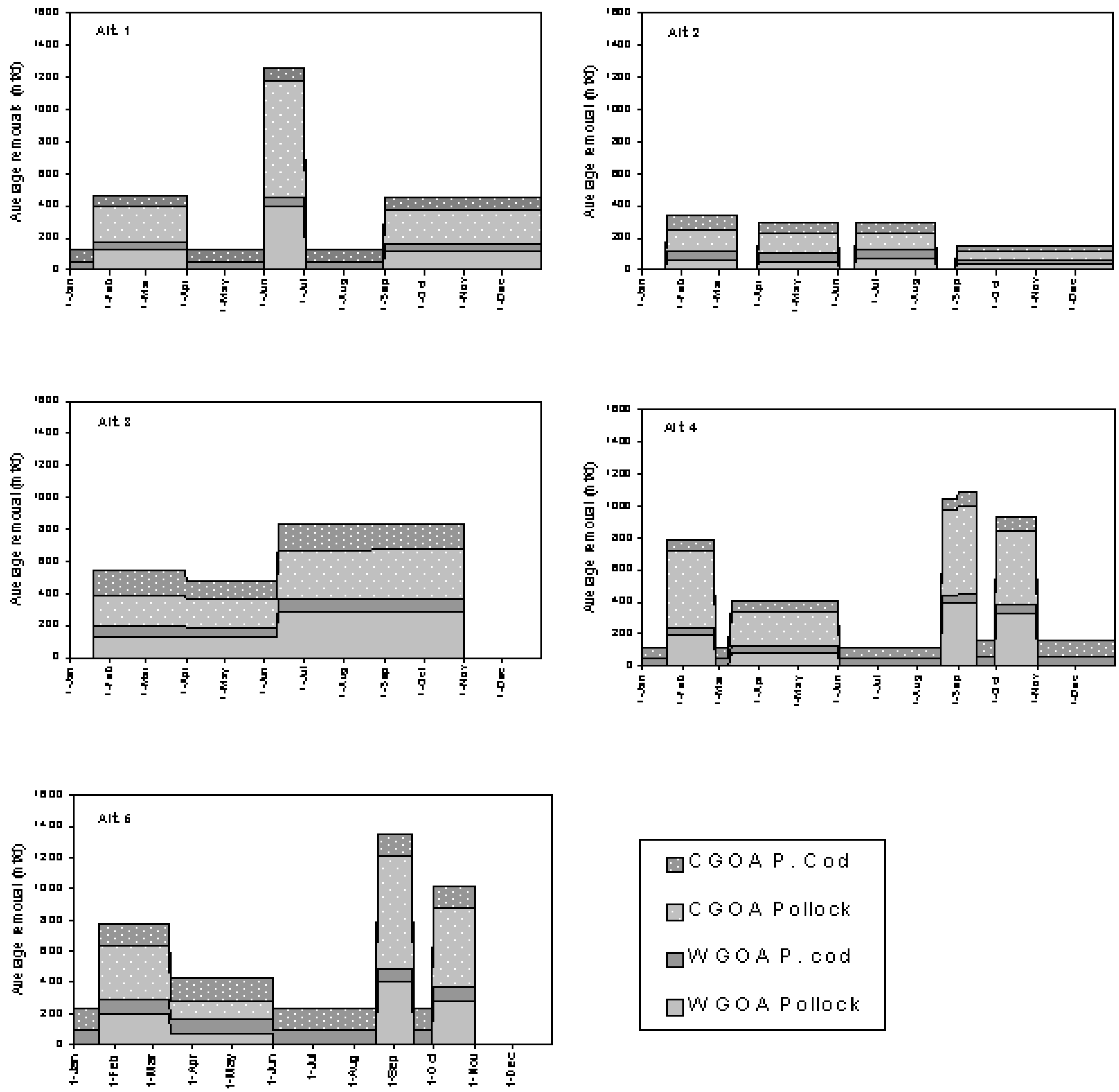

Figure 4.1-9 Projected average daily removal rates of Gulf of Alaska pollock and Pacific cod for each Alternative.

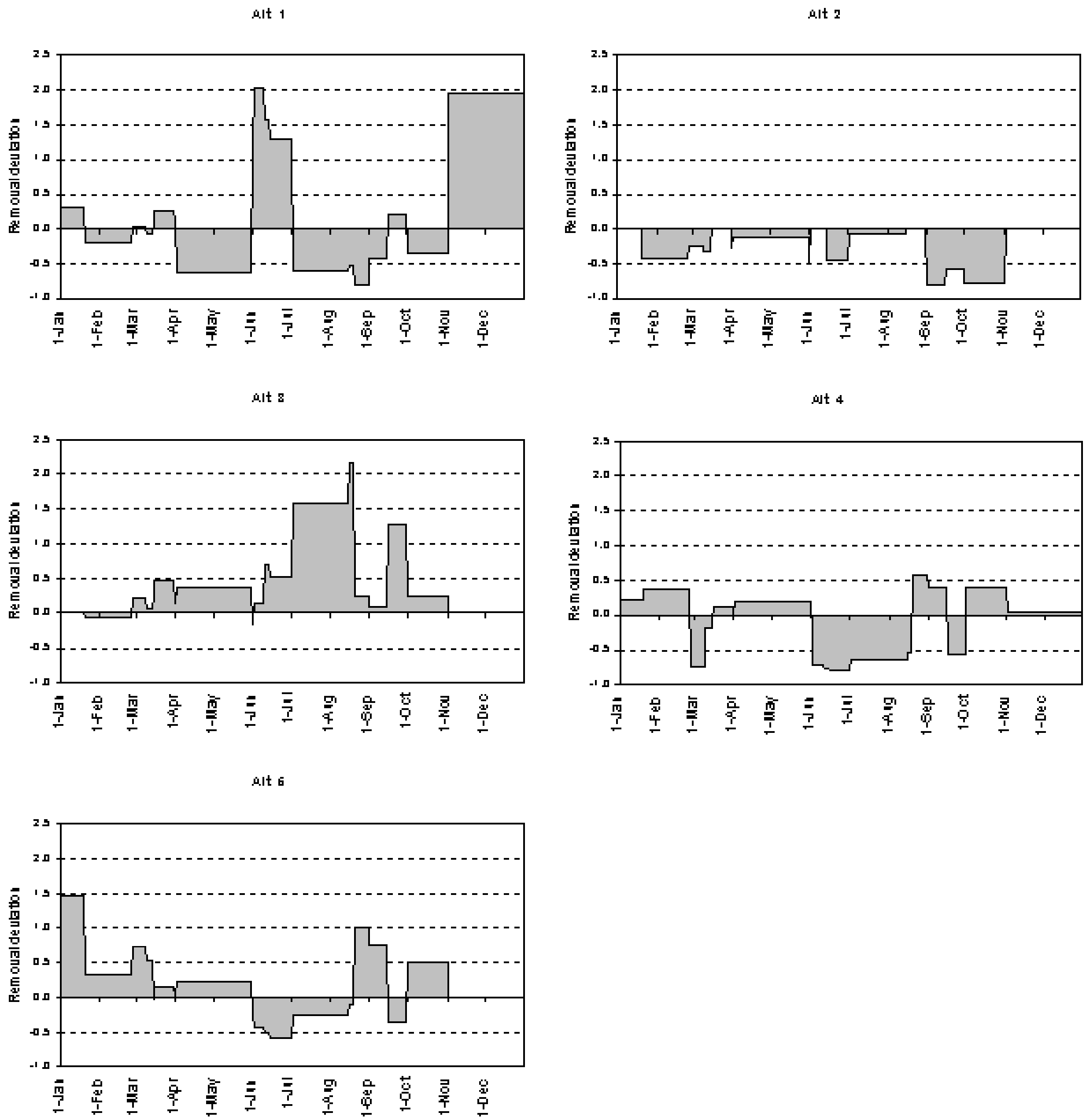

Figure 4.1-10 Deviations of relative mean daily removal rates for Gulf of Alaska pollock and Pacific cod fisheries based on projected seasonal allocation of total allowable catch for each Alternative.

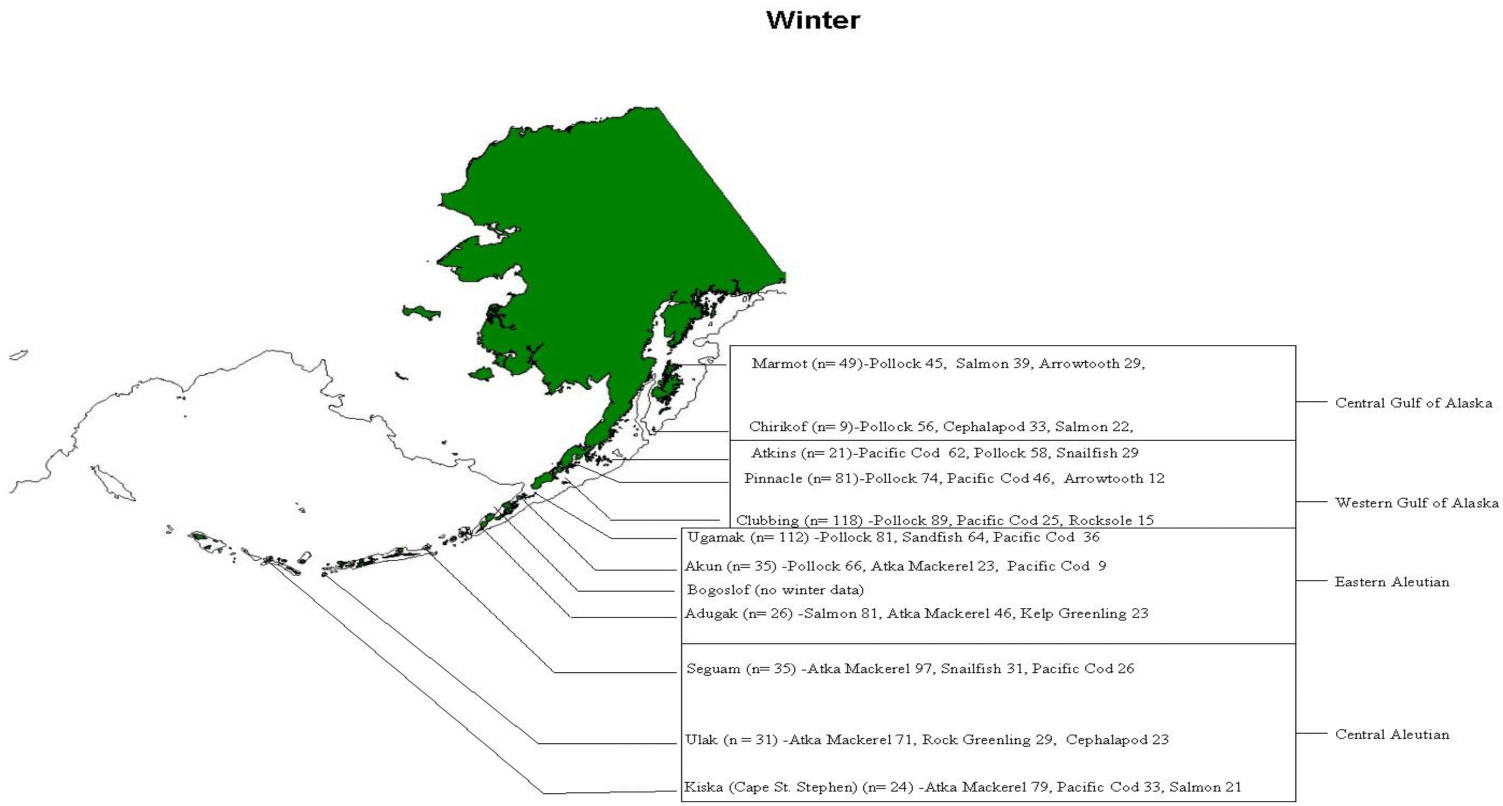

Figure 4.1-11 Percent frequency of occurrence of top three prey items found in Steller sea lion scats collected December through April, 1990-1998.

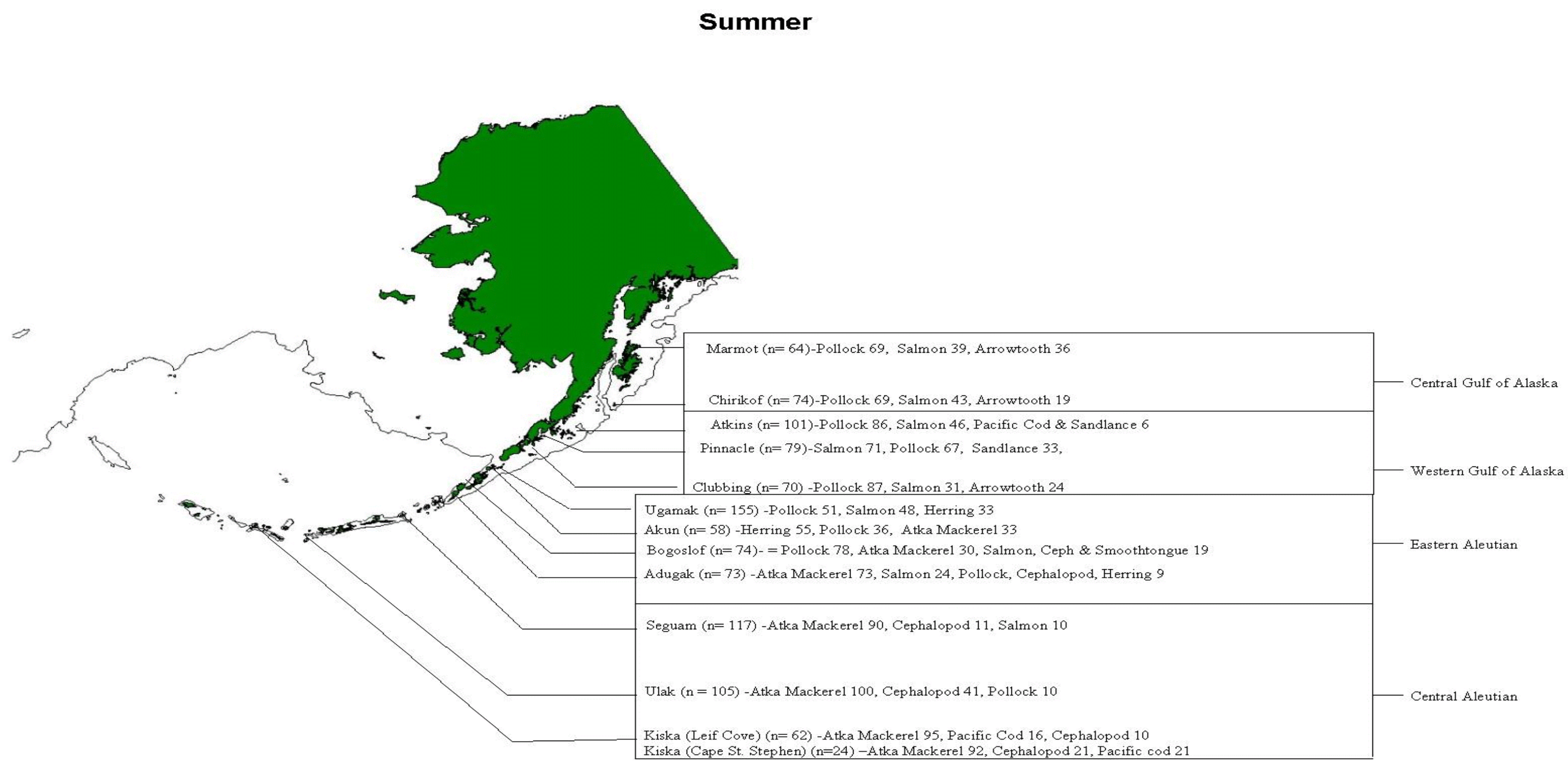

Figure 4.1-12 Percent frequency of occurrence of top three prey items found in Steller sea lion scats collected June through August, 1990-1999.

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